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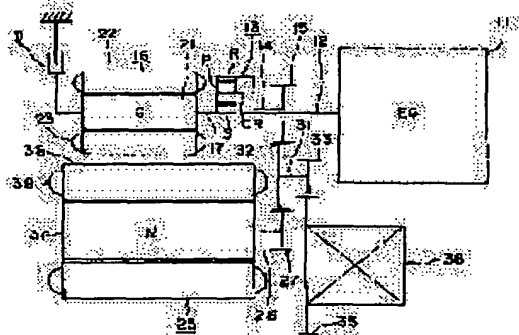
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(54) HYBRID VEHICLE

(57)Abstract:

PROBLEM TO BE SOLVED: To reduce the shock of engagement of a brake provided in a generator.

SOLUTION: This hybrid vehicle, in which an engine 11, a generator 16, and a drive output shaft 31 are connected to the gear elements of a planetary gear unit 13 so that it is driven by the output of an electric motor 25 connected to the drive output shaft 31 and by engine output, is designed to be capable of traveling in a non-generating mode in which the generator 16 is stopped by a brake B and in a generating mode in which the brake B is released, and the shock of engagement is reduced by engaging the brake B after bringing the number of revolutions of the generator close to zero. Also, the output torque of the electric motor 25 is adjusted in order to compensate for torque fluctuations during the control of the number of revolutions of the generator, and an upper limit is provided for the rate of change in the number of revolutions of the generator to reduce adverse effects on the engine 11.



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CLAIMS

[Claim(s)]

[Claim 1] The hybrid vehicles characterized by providing the following. Engine. The generator in which revolving speed control is possible. The drive output shaft which outputs the driving force of a driving wheel. The differential gear mechanism with which the 1st gearing element was connected with the output shaft of the aforementioned engine, the 2nd gearing element was connected with Rota of the aforementioned generator, and the 3rd gearing element was connected with the aforementioned drive output shaft, The engagement means arranged between the electric motor connected with the aforementioned drive output shaft, and Rota of the aforementioned generator and a stop member, Engagement control means which make the aforementioned engagement means an engagement state when the relative rotational frequency of the generator control means which control the rotational frequency of the aforementioned generator, and the Rota and the aforementioned stop member which were controlled by the aforementioned generator control means becomes within limits defined beforehand.

[Claim 2] The aforementioned stop members are hybrid vehicles according to claim 1 which are the cases which fix Rota of the aforementioned generator.

[Claim 3] The aforementioned stop members are hybrid vehicles according to claim 1 which are either among the gearing element of the above 1st, and the gearing element of the above 3rd.

[Claim 4] Furthermore, the hybrid vehicles according to claim 1 to 3 which have an amendment torque amendment means for the motor output torque of the aforementioned electric motor according to torque change produced by the revolving speed control by the aforementioned generator control means.

[Claim 5] The aforementioned generator control means are hybrid vehicles according to claim 1 to 4 which control the rate of change of the rotational frequency of the aforementioned generator within limits which were able to be defined beforehand.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the hybrid vehicles which run an engine and a motor as a driving source.

[0002]

[Description of the Prior Art] In order to realize low pollution and low mpg conventionally, the hybrid vehicles which have the driving gear which used the engine and the motor together are proposed, for example, a generator and an engine are connected using a differential gear mechanism, and U.S. Pat. No. 3566717 uses a part of output from an engine for power generation, and outputs the remainder to a direct-drive output shaft. By such hybrid vehicles, by controlling rotation of a generator, run mode can be changed to engine motor drive mode, motor drive mode, etc., and charge to the dc-battery of regeneration power and starting of an engine can be performed further.

[0003]

[Problem(s) to be Solved by the Invention] On the other hand, since the engine, the generator, and the drive motor are connected and each rotational frequency and torque are mutually related through a differential gear mechanism in the above-mentioned hybrid vehicles, the brake prepared in the generator for the purpose of making engine brake effective etc. may be made to act, and rotation of a generator may be fixed.

[0004] Here, if the rotational frequency of a generator is suddenly stopped by the brake, a shock will become large, and there will be a possibility that run feeling may be spoiled, and the friction material of a brake will be remarkably exhausted by generation of heat.

[0005] If a shocking absorber like an accumulator is formed in order to absorb such a shock for example, it is necessary to adjust an orifice, an accumulator spring, etc. for every vehicle, and the problem that manufacture and a maintenance take time and effort will arise. Moreover, it is influenced by aging of coefficient of friction of friction material, operational status, temperature, etc., and the effect which it was difficult to be stabilized and to maintain the shocking absorption effect of an accumulator, and was expected is not acquired in many cases.

[0006] Furthermore, if the above-mentioned shocking absorber is attached, a mechanism will become complicated and will become an electric vehicle with few loading spaces with the composition which is not desirable.

[0007] The purpose of this invention is by controlling a generator rotational frequency beforehand to offer the hybrid vehicles which suppressed the shock at the time of engagement of an engagement means.

[0008]

[Means for Solving the Problem] Such a purpose is attained by the following this inventions.

[0009] (1) An engine, the generator in which revolving speed control is possible, and the drive output shaft which outputs the driving force of a driving wheel, The differential gear mechanism with which the 1st gearing element was connected with the output shaft of the aforementioned engine, the 2nd

gearing element was connected with Rota of the aforementioned generator, and the 3rd gearing element was connected with the aforementioned drive output shaft, The engagement means arranged between the electric motor connected with the aforementioned drive output shaft, and Rota of the aforementioned generator and a stop member, The hybrid vehicles characterized by having the engagement control means which make the aforementioned engagement means an engagement state when the relative rotational frequency of the generator control means which control the rotational frequency of the aforementioned generator, and the Rota and the aforementioned stop member which were controlled by the aforementioned generator control means becomes within limits defined beforehand.

[0010] (2) The aforementioned stop members are hybrid vehicles given in the above (1) which is the case which fixes Rota of the aforementioned generator.

[0011] (3) the aforementioned stop member -- the gearing element of the above 1st, and the gearing element of the above 3rd -- inner -- hybrid vehicles given in the above (1) which is either

[0012] (4) The above (1) which furthermore has an amendment torque amendment means for the motor output torque of the aforementioned electric motor according to torque change produced by the revolving speed control by the aforementioned generator control means, or hybrid vehicles given in either of (3).

[0013] (5) The aforementioned generator control means are hybrid vehicles the above (1) which controls the rate of change of the rotational frequency of the aforementioned generator within limits which were able to be defined beforehand, or given in either of (4).

[0014]

[Function] The rotational frequency of a generator is controlled by generator control means, and after dropping a rotational frequency to the rotational frequency when changing into an engagement state by the engagement means, an engagement means is made into an engagement state by engagement control means. Thereby, in between [before making an engagement means engaged, after making it engaged], since there are few differences of the rotational frequency of a generator, the shock at the time of engagement by the engagement means is suppressed.

[0015] When a stop member is a case, generator control means control the rotational frequency of a generator so that the rotational frequency of a generator serves as zero, and an engagement means is engaged. An engagement means is made engaged, when a stop member is the 1st gearing element or the 3rd gearing element and the rotational frequency of the 2nd gearing element connected to Rota of a generator becomes the same as the rotational frequency of other 1st gearing element or the 3rd gearing element. Thereby, the 1st gearing element, the 2nd gearing element, and the 3rd gearing element rotate as one.

[0016] If the rotational frequency of a generator is controlled by generator control means, the output torque outputted to a drive output shaft from a differential gear mechanism will be changed. the motor output torque of the electric motor connected with the drive output shaft here -- a torque amendment means -- change of an output torque -- responding -- an amendment -- engagement of an engagement means can be performed by things, without spoiling run feeling

[0017] Since an engine may blow the rotational frequency of a generator when making it change to the rotational frequency at the time of engagement of an engagement means and the rate of change of a rotational frequency is too large, and the same shock as a riser and the shock at the time of engagement may arise by generator control means, it is controlled so that the rate of change of a rotational frequency does not exceed within the limits defined beforehand.

[0018]

[Embodiments of the Invention]

The 1st operation gestalt of the hybrid vehicles of this invention is explained in detail based on an accompanying drawing below the <1st operation gestalt>.

[0019] Drawing 1 is the conceptual diagram showing the driving gear of the hybrid vehicles of the 1st operation gestalt of this invention. The engine output shaft 12 which outputs the rotation generated by making an engine 11 and an engine 11 drive on the 1st axis in drawing, The planetary gear unit 13 which is the differential gear mechanism which changes gears to the rotation inputted through this

engine output shaft 12, The unit output shaft 14 to which the rotation after the gear change in this planetary gear unit 13 is outputted, The transfer shaft 17 which connects the 1st counter drive gear 15 fixed to this unit output shaft 14, the generator 16 which acts mainly as generators in a run state, this generator 16, and the planetary gear unit 13 is usually arranged. The unit output shaft 14 has a sleeve configuration, surrounds the engine output shaft 12 and is arranged. Moreover, the 1st counter drive gear 15 is arranged in the engine 11 side from the planetary gear unit 13.

[0020] The planetary gear unit 13 is equipped with the carrier CR which is the 1st gearing element supported free [rotation of the starter ring R and Pinion P which are the 3rd gearing element which gears with the pinion P which gears with the sun gear S which is the 2nd gearing element, and a sun gear S, and this pinion P].

[0021] A sun gear S is connected with a generator 16 through the transfer shaft 17, a starter ring R is connected with the 1st counter drive gear 15 through the unit output shaft 14, and Carrier CR is connected with the engine 11 through the engine output shaft 12.

[0022] Furthermore, it was fixed to the transfer shaft 17 and the generator 16 is equipped with Rota 21 arranged free [rotation], the stator 22 arranged around this Rota 21, and the coil 23 around which this stator 22 was looped. A generator 16 generates power by rotation transmitted through the transfer shaft 17. It connects with the battery which is not illustrated, and the aforementioned coil 23 supplies power to this battery, and charges it.

[0023] The brake B which is an engagement means is connected to the other end side of the transfer shaft 17, by making this brake B into an engagement state, Rota 21 is fixed to a generator 16 and rotation of a generator 16 and rotation of a sun gear S are stopped. On the 2nd axis parallel to the 1st axis, the electric motor 25, the motor output shaft 26 to which rotation of an electric motor 25 is outputted, and the 2nd counter drive gear 27 fixed to the motor output shaft 26 are arranged.

[0024] It was fixed to the motor output shaft 26, and the electric motor 25 is equipped with Rota 37 arranged free [rotation], the stator 38 arranged around this Rota 37, and the coil 39 around which this stator 38 was looped. An electric motor 25 generates torque by the current supplied to a coil 39. Therefore, it connects with the battery which is not illustrated, and the coil 39 is constituted so that current may be supplied from this battery.

[0025] The hybrid vehicles of this invention generate regeneration power in response to rotation in a slowdown state from the driving wheel which an electric motor 25 does not illustrate, and this regeneration power is supplied to a battery and it charges. And in order to rotate the driving wheel which is not illustrated in the same direction as rotation of the aforementioned engine 11, on the 3rd axis parallel to the 1st axis and the 2nd axis, the counter shaft 31 is arranged as a drive output shaft. The counter driven gear 32 is being fixed to this counter shaft 31.

[0026] moreover, this counter driven gear 32, the 1st counter drive gear 15, and the counter driven gear 32 and the 2nd counter drive gear 27 make it gear -- having -- the [of the 1st counter drive gear 15 / rotation and] -- rotation of 2 counter drive gear 27 is reversed, and it is transmitted to the counter driven gear 32

[0027] Furthermore, the differential-gear pinion gear 33 with a number of teeth smaller than the counter driven gear 32 is fixed to the counter shaft 31. And the differential-gear starter ring 35 is arranged on the 4th axis parallel to the 1st axis, the 2nd axis, and the 3rd axis, and this differential-gear starter ring 35 and the aforementioned differential-gear pinion gear 33 are meshed. Moreover, differential equipment 36 is fixed to the aforementioned differential-gear starter ring 35, and by the aforementioned differential equipment 36, the rotation transmitted to the differential-gear starter ring 35 is made to carry out differential, and is transmitted to a driving wheel. The drive output system is constituted by the planetary gear unit 13, a generator 16, the 1st counter drive gear 15, the counter driven gear 32, the 2nd counter drive gear 27, the counter shaft 31, the differential-gear pinion gear 33, the differential-gear starter ring 35, and differential equipment 36 in the above-mentioned composition.

[0028] Thus, since it not only can transmit the rotation generated with the engine 11 to the counter driven gear 32, but the rotation generated by the electric motor 25 can be transmitted to the counter driven gear 32, it can be made to run hybrid vehicles in the engine motor drive mode in which the

engine drive mode in which only an engine 11 is driven, the motor drive mode in which only an electric motor 25 is driven, an engine 11, and an electric motor 25 are driven. Moreover, the rotational frequency of the aforementioned transfer shaft 17 is controllable by controlling the power generated in a generator 16. Moreover, when stopping rotation of a generator, Rota 21 of charge doubling, now a generator 16 can be fixed for Brake B. In this case, by carrying out engagement release of the brake B, it can consider as the mode it runs while generating electricity with a generator 16 in the state of brake release, and can consider as the mode it runs, without generating electricity with a generator 16 in the state of brake engagement.

[0029] Operation of the planetary gear unit 13 of the hybrid vehicles of the above-mentioned composition is explained. The velocity diagram at the time of the usual run of the planetary gear unit [in / the 1st operation form of this invention / drawing 2 (A) and / in drawing 2 (B)] 13 to the conceptual diagram of the planetary gear unit 13 (drawing 1) of the 1st operation form of this invention and drawing 3 are the torque diagrams at the time of a usual run of the planetary gear unit 13 in the 1st operation form of this invention.

[0030] In this operation form, the number of teeth of the starter ring R of the planetary gear unit 13 serves as double precision of the number of teeth of a sun gear S as shown in drawing 2 (A). Therefore, the rotational frequency of the unit output shaft 14 connected to a starter ring R (it is called a "starter-ring rotational frequency" below.) The rotational frequency of the engine output shaft 12 connected to Carrier CR (it is called a "engine speed" below.) The rotational frequency of the transfer shaft 17 which sets to NE and is connected to a sun gear S (it is called a "generator rotational frequency" below.) It is [0031] as the relation of NR, NE, and NG is shown in drawing 2 (B), when referred to as NG. $NG=3$ and $NE=2$, NR [0032] It becomes. Moreover, it is [0033] as the relation of TR, TE, and TG is shown in drawing 3 , when torque (henceforth "starter-ring torque") outputted to the unit output shaft 14 from a starter ring R is set to TR, torque (henceforth a "engine torque") of an engine 11 is set to TE and generator torque is set to TG. It is set to $TE:TR:TG=3:2:1$.

[0034] And each is rotated for a starter ring R, Carrier CR, and a sun gear S by the right direction at the time of a usual run of hybrid vehicles, and as shown in drawing 2 (B), the starter-ring rotational frequency NR (= output rotational frequency NOUT), the rotational frequency NE of an engine, and the generator rotational frequency NG all take a positive value.

[0035] And an engine torque TE is inputted into Carrier CR, and this engine torque TE can receive with the reaction force of the 1st counter drive gear 15 shown in drawing 1 , and a generator 16.

Consequently, the starter-ring torque TR is outputted to the unit output shaft 14 from a starter ring R, and the generator torque TG is outputted to the transfer shaft 17 from a sun gear S as shown in drawing 3 .

[0036] The above-mentioned starter-ring torque TR and the generator torque TG are acquired by dividing an engine torque TE proportionally by the torque ratio determined with the number of teeth of the planetary gear unit 13, and what added the starter-ring torque TR and the generator torque TG on the torque diagram serves as an engine torque TE.

[0037] Next, the control system of the hybrid vehicles of this invention is explained in detail based on the block diagram of drawing 4 . The control means which constitute the control system of this operation form have the vehicles control unit 41, an engine control system 42, motor control equipment 43, and arrangement for controlling electric generator 44. The microcomputer equipped with ROM (lead-on memory) in which CPU (central processing unit), and various programs and data were stored, RAM (random access memory) used as a working area can constitute these control units 41, 42, 43, and 44.

[0038] Furthermore, this control system is equipped with the accelerator sensor 45 which detects the accelerator opening alpha which shows the degree of demand to an operator's vehicles driving force, and the vehicle speed sensor 46 which detects the vehicle speed V. The detection value detected by each sensor 45 and 46 is supplied to the vehicles control unit 41.

[0039] The vehicles control unit 41 controls the whole hybrid vehicles, determines torque TM^* according to the vehicle speed V from the accelerator opening alpha and the vehicle speed sensor 46

from the accelerator sensor 45, makes this motor torque instruction value TM^* , and supplies it to motor control equipment 43. Moreover, amendment torque ΔTM required in order to absorb the torque change by the revolving speed control of a generator 16 by the electric motor 25 is supplied to motor control equipment 43.

[0040] Amendment torque ΔTM is computed as follows. If generator inertia is set to InG and the rotation rate of change (angular acceleration) of a generator 16 is set to βG , the sun gear torque TS which acts on a sun gear S will be set to $TS = TG + InG \cdot \beta G$. In addition, rotation rate-of-change βG turns into $TS = TG$, in being very small. And as mentioned later, when the number of teeth of a starter ring R is the double precision of a sun gear S , the starter-ring torque TR serves as double precision of the generator torque TG , and change torque (amendment torque) ΔTM which should be absorbed by the electric motor 25 will become $\Delta TM = 2 \cdot i \cdot TS = 2 \cdot i \cdot (TG + InG \cdot \beta G)$, if a counter-gear ratio is set to i .

[0041] Moreover, the vehicles control unit 41 supplies an engine ON/OFF signal to an engine control system 42. Specifically according to ON/OFF of an ignition key, an engine ON/OFF signal is supplied.

[0042] The vehicles control unit 41 supplies control-objectives rotational frequency NG^* of a generator 16 to arrangement for controlling electric generator 44. As function $NG^* = f(\alpha)$ of the accelerator opening α supplied from the accelerator sensor 45, target rotational frequency NG^* is decided as shown in drawing 5. That is, in the case of $\alpha > 20\%$ of accelerator opening, target rotational frequency NG^* is greatly decided in proportion to the accelerator opening α , and is decided to be $\alpha \leq 20\%$ of case by $NG^* = 0$.

[0043] Furthermore, the vehicles control unit 41 supplies an ON/OFF signal to the electro-magnetic valve 54 which operates Brake B. The solenoid built in the electro-magnetic valve 54 based on the ON/OFF signal supplied operates, for example, when it is ON signal, a solenoid operates, a bulb is opened wide, the pressure oil from an oil pump is supplied to a brake actuator, Brake B is made into an engagement state, in the case of an OFF signal, a bulb is closed and an electro-magnetic valve 54 cancels engagement of Brake B. Engagement control means consist of a hydraulic circuit equipped with the electro-magnetic valve 54 and the brake actuator, and a vehicles control unit 41.

[0044] The vehicles control unit 41 performs the following operation, in order to suppress the shock by engagement of Brake B. In order to suppress the shock produced by engagement of Brake B, it is necessary to lessen change of the torque by engagement of Brake B, and the change torque of the generator 16 at the time of brake engagement is acquired by $\Delta TG = InG \cdot \beta G$ like previous statement. That is, by lessening βG for rotation rate of change, the shock by brake engagement can be made small, and consumption of friction material can also be mitigated. The vehicles control unit 41 controls the generator rotational frequency NG to become a rotational frequency at the time of brake B engagement (zero), before supplying ON signal to an electro-magnetic valve 54, and it is engaged in Brake B after that. Consumption of the friction material of Brake B is not enlarged at this time, but Brake B is engaged, when making Brake B engaged is set up as a range as which ΔNG^* rotational frequency allowed value ΔNG^* was determined beforehand and absolute value $|NG|$ of a real rotational frequency becomes small from rotational frequency allowed value ΔNG^* in the range which does not tell an operator a shock. Since rotation rate-of-change βG when a rotational frequency changes from before brake B engagement to the engagement back becomes small by this, the shock at the time of brake engagement is mitigated.

[0045] An engine control system 42 is switched to the drive state (ON state) which is outputting the engine torque for the engine 11, and the state (OFF state) where the engine torque is not generated and where it does not drive, based on the selection command signal inputted from the vehicles control unit 41. Moreover, the output of an engine 11 is controlled by controlling the throttle opening θ according to the actual engine speed NE inputted from the rotational frequency sensor formed in the engine 11. This engine speed NE and the throttle opening θ are inputted also into the vehicles control unit 41.

[0046] Motor control equipment 43 controls the current (torque) IM of an electric motor 25 to become $TM = TM^*$, when amendment torque ΔTM is not supplied when amendment torque ΔTM is

supplied from the vehicles control unit 41 so that it may be set to $TM = TM^* - \Delta TM$ and. Always defined torque TM^* is maintained by this, without influencing an output torque of the revolving speed control of a generator 16. A torque amendment means is constituted by the vehicles control unit 41 and motor control equipment 43.

[0047] Arrangement for controlling electric generator 44 controls the rotational frequency NG of a generator 16, and controls Current (torque) IG to become control-objectives rotational frequency NG inputted from the vehicles control unit 41, or control-objectives torque TG^* . Moreover, arrangement for controlling electric generator 44 acts to the output torque TG of a generator 16 as the monitor of the real rotational frequency NG of a generator 16, and inputs the value into the vehicles control unit 41, respectively. Generator control means are constituted by the vehicles control unit 41 and arrangement for controlling electric generator 44.

[0048] Next, operation of the hybrid vehicles of this operation form constituted as mentioned above is explained. By the hybrid vehicles of this operation form, the accelerator opening α fixes rotation of a generator by making Brake B into an engagement state, in being small. By this, it becomes unnecessary to pass current to a generator 16, the power consumption in a generator 16 can be mitigated, and power can be saved.

[0049] Moreover, since the accelerator opening α becomes large [the power consumption of an electric motor 25] in being large, in proportion to the accelerator opening α , the rotational frequency of a generator 16 is raised by making Brake B into an open state, and the amount of power generation is made to increase. With this operation form, when the accelerator opening α is 20% or less, Brake B is made engaged and a generator 16 is fixed, and when it is 20% or more, it generates electricity by opening Brake B wide.

[0050] Hereafter, the control action of hybrid vehicles is explained in detail. Drawing 6 is a flow chart which shows the control action of hybrid vehicles. The accelerator opening α is read in the accelerator sensor 45 (Step S11), and the accelerator opening α judges whether it is 20% or less (Step S12). When the accelerator opening α is 20% or less, as for the vehicles control unit 41, Brake B judges whether it is an engagement state (ON state) (Step S13). In being in an engagement state, it maintains (Step S13:Y) a state as it is, and a return is carried out to a main routine.

[0051] When it is got blocked and the accelerator opening α is 20% or less, when Brake B is in a release state (OFF state), and Brake B is in a release state (Step S13: N), it judges whether rotation of a generator 16 may be fixed. That is, absolute value $|NG|$ of the generator rotational frequency NG judges whether it is below allowed value ΔNG^* (Step S14).

[0052] | In being $NG < \Delta NG^*$, (Step S14:Y) and the vehicles control unit 41 supply ON signal to an electro-magnetic valve 54, are engaged (Step S18) and carry out the return of the brake B to a main routine. A generator 16 is fixed by engagement of Brake B and the power loss in a generator 16 is suppressed.

[0053] | In being $NG \geq \Delta NG^*$, it is referred to as $NG^* = 0$ according to (Step S14:N) and drawing 5 (Step S15), and supply this to arrangement for controlling electric generator 44 (Step S16). Here, the vehicles control unit 41 acts as the monitor of the generator real rotational frequency NG through arrangement for controlling electric generator 44, and it judges whether absolute value $|NG|$ of the generator rotational frequency NG became below allowed value ΔNG^* like Step 14 (Step S17). | Repeat Step S17 until it becomes $NG < \Delta NG^*$ (Step S17: N), and by control by arrangement for controlling electric generator 44, when it becomes $NG < \Delta NG^*$ (step S17:Y), supply ON signal to an electro-magnetic valve 54, and the vehicles control unit 41 is engaged (Step S18), and carries out the return of the brake B to a main routine.

[0054] Here, in Step S16, after target rotational frequency NG^* is supplied, by the control action by which arrangement for controlling electric generator 44 turns the real rotational frequency NG to target rotational frequency NG^* , and controls it, the real rotational frequency NG is controlled in the range which does not exceed upper limit rate-of-change ΔNG_{MAX} (rpm/sec) whose rate of change of the real rotational frequency NG is the range defined beforehand. Since the generator 16 and the engine 11 are connected through the planetary gear unit 13, when the rotational frequency NG of a generator 16 is

controlled rapidly, they have an engine 11 or a possibility of having a bad influence on the amount and mpg of exhaust gas, such as blowing up. Then, the above-mentioned upper limit rate-of-change ΔNG_{MAX} is set up as rate of change of the limitation which does not do the above-mentioned bad influence.

[0055] Drawing 7 shows upper limit rate-of-change ΔNG_{MAX} . Upper limit rate-of-change ΔNG_{MAX} is set up so that it may become so large that the value of the accelerator opening α is large as illustrated. In addition, this upper limit rate-of-change ΔNG_{MAX} is good also as constant value, without setting up as a function of the accelerator opening α .

[0056] In Step S12, in being larger than 20%, Brake B judges [the accelerator opening α inputted at Step S11] whether it is an engagement state (ON state) (Step S19). When Brake B is in a release state (OFF state), after (Step S19:N) and the vehicles control unit 41 determine target rotational frequency NG^* of a generator 16 from the accelerator opening α (Step S20) and supply this to arrangement for controlling electric generator 44 based on drawing 5 (Step S21), the return of them is carried out to a main routine. On the other hand, when Brake B is in an engagement state, (Step S19:Y) and the vehicles control unit 41 hold the torque TG of a generator 16 to set point TG^* which becomes settled by the engine torque TE in order to hold the rotational frequency of a generator 16 (Step S22). Then, the vehicles control unit 41 supplies an OFF signal to an electro-magnetic valve 54, opens engagement of Brake B wide, and makes it a release state (OFF state) (Step S23).

[0057] Next, operation of the driving gear of the hybrid vehicles of this invention is explained based on the timing diagram shown in drawing 8. At time t_1 , it gets into an accelerator, accelerator opening changes to α_2 from α_1 , and time t_2 explains operation when accelerator opening changes from α_2 to α_1 as shown in drawing 8. Here, you may be $\alpha_1 < 20\%$, $\alpha_2 > 20\%$.

[0058] As for a generator 16, accelerator opening is fixed by engaging Brake B in the state of α_1 (ON state), the rotational frequency has become a zero state, and the generator torque TG also serves as zero. Moreover, it is the motor [torque / motor / TM] torque TM_1 according to the accelerator opening α_1 . It has become.

[0059] time t_1 the output torque corresponding to the accelerator opening α_2 when it set and accelerator opening changed from α_1 to α_2 -- it should output -- the motor torque TM -- TM_1 from -- TM_2 It goes up. Brake B is in ON state at this time (a dotted line A shows drawing 8). It is below the same.

[0060] In order for the engine 11 by release of Brake B to blow and to prevent a riser, generator torque is beforehand raised to generator torque TG^* which becomes settled by the engine torque TE at that time. After becoming $TG = TG^*$, in time t_{12} , Brake B is taken off (OFF) and a generator raises the generator rotational frequency NG below by the rotational frequency rate of change defined beforehand simultaneously (dotted line B). In this operation gestalt, while ordering it target rotational frequency NG^* of a generator 16, the generator torque TG is always computed and amendment torque ΔTM is added (dotted line C). For this reason, amendment torque ΔTM according to change of the generator torque TG is added to the motor torque TM as shown in drawing 8 (dotted line D).

[0061] The generator rotational frequency NG reaches target rotational frequency NG^* , without going up rapidly (dotted line E). since there is no upheaval of the generator rotational frequency NG in the meantime -- an engine 11 -- blowing up -- etc. -- a bad influence called the aggravation of mpg and the increase in an exhaust gas to depend is not produced

[0062] the attainment, simultaneously the generator 16 to target rotational frequency NG^* are controlled to hold target rotational frequency NG^* . Since elevation of the generator rotational frequency NG stops, the absolute value of the generator torque TG becomes larger than the time of the rotational frequency rising (dotted line F). If amendment torque ΔTM is added to the motor torque TM (dotted line G) and the generator rotational frequency NG also reaches target rotational frequency NG^* in the meantime, since the absolute value of the generator torque TG will become large, the motor torque TM becomes small about it at an amendment sake (dotted line H).

[0063] When accelerator opening changes to α_1 from α_2 , the motor torque TM is TM_2 that the output torque according to the accelerator opening α_1 should be outputted. Shell TM_1 It descends.

Brake B is in the OFF state at this time (dotted line I). Next, the generator torque TG is made to increase and amendment torque ΔTM according to change of the generator torque TG is simultaneously amended to the motor torque TM to make the generator rotational frequency NG into the zero which are a rotational frequency in a brake engagement state (ON) (dotted line J). When the generator rotational frequency NG descends, without changing rapidly (dotted line K) and it becomes small rather than ΔNG^* , it is time t_{22} and Brake B is engaged (dotted line L). (ON) since there is no upheaval of the generator rotational frequency NG in the meantime -- an engine 11 -- blowing up -- etc. -- a bad influence called the aggravation of mpg and the increase in an exhaust gas to depend is not produced [0064] since, as for the motor torque TM, torque amendment is performed (dotted line M), maintenance of run feeling is achieved and the generator torque TG becomes small with engagement of Brake B, while the generator rotational frequency NG is descending -- the motor torque TM -- the part -- it becomes large -- it becomes (dotted line N) And when a generator 16 is completely fixed by Brake B, the generator torque TG serves as zero (dotted line O).

[0065] Although the above explanation explained the control action to which the accelerator opening α carries out engagement release of the brake B bordering on the state of being 20% In this invention, it is not what is limited to the above-mentioned operation. by manual operation It can apply, when switching to the mode it runs while generating run mode with a generator 16, and the mode it runs, without generating electricity with a generator 16. In addition, in order to make engine brake act, when it fixes Rota 21 of a generator 16 and fixes Rota 21 of a generator 16 during a run, it can use.

[0066] In addition, what kind of brake is sufficient as the brake B used in the operation gestalt which gave [above-mentioned] explanation. In this case, although any of a wet brake and a dry type brake are sufficient, it is desirable to use a wet brake at the point which is easy to control a rotational frequency.

[0067] The <2nd operation gestalt>, next the 2nd operation gestalt of this invention are explained.

Drawing 9 is the conceptual diagram showing the composition of the driving gear of the 2nd operation gestalt. By the hybrid vehicles of this operation gestalt, in the planetary gear unit 13, the clutch C which is an engagement means is formed between Carrier CR and the sun gear S, and the brake B currently arranged by the generator 16 in the 1st operation gestalt is not formed. Moreover, as for Clutch C, engagement and release are controlled by the actuator by which an ON/OFF signal is supplied from the vehicles control unit 41. About other structures, since it is the same as that of the 1st operation gestalt, the same sign is given to the same composition as drawing 1, and explanation is omitted.

[0068] Operation of the driving gear of the 2nd operation gestalt is explained. Clutch C is usually in the release state (OFF state) at the time of a run, and is made into an engagement state (ON state) at the time of acceleration.

[0069] Usually, by the time of a run, the planetary gear unit 13 has become open, and it is rotating at the rotational frequency of which Clutch C is canceled and from which a sun gear S, Carrier CR, and a starter ring R differ independently, respectively as shown in drawing 2 (B). With the **** 2 operation gestalt, since the number of teeth of a starter ring R serves as double precision of a sun gear S, the gear ratio of an engine 11 to the unit output shaft 14 is two thirds.

[0070] And in the time of the acceleration run with which Clutch C is engaging, each gearing element of the planetary gear unit 13 is really rotated, and becomes the same [the rotational frequency of each gearing element]. The gear ratio of an engine 11 to the unit output shaft 14 at this time is set to 1, and the output transmitted to the unit output shaft 14 from an engine 11 increases by 1.5 times as compared with the time of Clutch C being in a release state. The output transmitted to the counter shaft 31 which is a drive output shaft by this increases, and acceleration is performed.

[0071] Next, the control action of the 2nd operation gestalt is explained. Drawing 10 is a timing diagram which shows control action. Hereafter, from the state of α_1 , it is made to increase to α_2 and accelerator opening is accelerated, and control action at the time of changing the accelerator opening after an acceleration end to α_3 is made into an example, and it explains.

[0072] Usually, in the run state, Clutch C is in the release state (OFF state) by α_1 , and accelerator opening is set as the value [torque / motor / TM / the rotational frequency NG of a generator 16, Torque TG, and] corresponding to the accelerator opening α_1 and the vehicle speed V respectively.

[0073] time t1 the output torque corresponding to the accelerator opening alpha 2 in order to set and accelerate, when accelerator opening was made to increase to alpha 2 from alpha 1 -- it should output -- the motor torque TM -- TM1 from -- TM2 It goes up. Clutch C is in the OFF state at this time (a dotted line a shows drawing 8). It is below the same.

[0074] In order to consider as the output rotational frequency NOUT into which the generator rotational frequency NG is inputted by the generator 16 at the starter ring R, it is target rotational frequency NG*2. It is set as NOUT and the generator torque TG is decreased. Thereby, the generator rotational frequency NG is target rotational frequency NG*2. It turns and begins (dotted line b) to increase. To the motor torque TM, amendment torque deltaTM according to change of the generator torque TG is amended simultaneously (dotted line c). The generator rotational frequency NG rises, without changing rapidly (dotted line d), and is the real rotational frequency NG and target rotational frequency NG*2. When a difference becomes smaller than deltaNG*, it is time t12 and Clutch C is engaged (dotted line g). (ON) Here, deltaNG* is the real rotational frequency NG at the time of being the value set up in the range which does not enlarge exhaustion of the friction material of Clutch C and does not tell an operator a shock, and making Clutch C engaged, and target rotational frequency NG*2. It is the allowed value of a difference.

[0075] Time t2 If it sets, and an acceleration run is completed, accelerator opening is decreased from alpha 2 to alpha 3 and it is usually a run, the motor torque TM will be decreased according to the accelerator opening alpha (dotted line j). Moreover, in order for the engine 11 by canceling Clutch C in the state where torque is not added to a generator 16 to blow and to suppress a riser, it asks for generator torque TG* which becomes settled by the engine torque TE at that time, and generator torque is beforehand raised to TG* (dotted line i).

[0076] It is target rotational frequency NG*3 so that Clutch C may be canceled in time t22 after becoming TG=TG* (OFF), and the generator rotational frequency NG may not exceed the upper limit of rotational frequency rate of change simultaneously. It turns and begins (dotted line k) to descend. Moreover, amendment torque deltaTM according to change of the generator torque TG is added to the motor torque TM (dotted line m). The generator rotational frequency NG is target rotational frequency NG*3, without descending rapidly (dotted line n). It reaches.

[0077] In addition, although any of a wet clutch and a dry clutch are sufficient as the clutch C used in the operation gestalt which gave [above-mentioned] explanation, it is desirable to use a wet clutch at the point which can mitigate the shock at the time of engagement. By using a wet clutch, the shock at the time of clutch C engagement can be suppressed further.

[0078] Moreover, the clutch C which is the above-mentioned engagement means may be formed between the sun gear S which is the 2nd gearing element, and the starter ring R which is the 3rd gearing element, and may be prepared between Carrier CR and the starter ring R. The control method of the generator rotational frequency NG in this case is the same as that of the case of the above-mentioned 2nd operation gestalt.

[0079]

[Effect of the Invention] The shock at the time of engagement by **** and the engagement means whose difference of the rotational frequency of a generator decreases is suppressed in between [after invention according to claim 1 explained above made it engaged before making an engagement means engaged]. Thereby, the endurance of an engagement means improves, and since the thermal load which friction material receives especially is mitigated, the endurance of friction material improves remarkably. Moreover, tuning of a buffer etc. becomes unnecessary, while simplification and lightweight-izing of a drive are realizable, since equipments, such as an accumulator which buffers the shock at the time of engagement, become unnecessary. Furthermore, since it is rare to receive a bad influence from aging of friction material, change of operational status and temperature, etc., the stable shock depressor effect continues and is obtained.

[0080] Invention according to claim 2 can suppress the shock by the magneto-rotor fixation at the time of switching to a non-generating electricity run from a power generation run.

[0081] Invention according to claim 3 can suppress the shock by the clutch engagement when usually

moving from a run to an acceleration run, for example.

[0082] Since invention according to claim 4 amends motor torque and absorbs torque change produced at the time of generator revolving speed control, it can maintain run feeling in the good state.

[0083] By controlling the rate of change of a generator rotational frequency within limits which were able to be defined beforehand, the abrupt change of a generator rotational frequency is suppressed and invention according to claim 5 can lessen the bad influence to mpg, the amount of exhaust gas, etc. of an engine.

[Translation done.]

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TECHNICAL FIELD

[The technical field to which invention belongs] this invention relates to the hybrid vehicles which run an engine and a motor as a driving source.

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PRIOR ART

[Description of the Prior Art] In order to realize low pollution and low mpg conventionally, the hybrid vehicles which have the driving gear which used the engine and the motor together are proposed, for example, a generator and an engine are connected using a differential gear mechanism, and U.S. Pat. No. 3566717 uses a part of output from an engine for power generation, and outputs the remainder to a direct-drive output shaft. By such hybrid vehicles, by controlling rotation of a generator, run mode can be changed to engine motor drive mode, motor drive mode, etc., and charge to the dc-battery of regeneration power and starting of an engine can be performed further.

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EFFECT OF THE INVENTION

[Effect of the Invention] The shock at the time of engagement by **** and the engagement means whose difference of the rotational frequency of a generator decreases is suppressed in between [after invention according to claim 1 explained above made it engaged before making an engagement means engaged]. Thereby, the endurance of an engagement means improves, and since the thermal load which friction material receives especially is mitigated, the endurance of friction material improves remarkably. Moreover, tuning of a buffer etc. becomes unnecessary, while simplification and lightweight-izing of a drive are realizable, since equipments, such as an accumulator which buffers the shock at the time of engagement, become unnecessary. Furthermore, since it is rare to receive a bad influence from aging of friction material, change of operational status and temperature, etc., the stable shock depressor effect continues and is obtained.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] On the other hand, since the engine, the generator, and the drive motor are connected and each rotational frequency and torque are mutually related through a differential gear mechanism in the above-mentioned hybrid vehicles, the brake prepared in the generator for the purpose of making engine brake effective etc. may be made to act, and rotation of a generator may be fixed.

[0004] Here, if the rotational frequency of a generator is suddenly stopped by the brake, a shock will become large, and there will be a possibility that run feeling may be spoiled, and the friction material of a brake will be remarkably exhausted by generation of heat.

[0005] If a shocking absorber like an accumulator is formed in order to absorb such a shock for example, it is necessary to adjust an orifice, an accumulator spring, etc. for every vehicle, and the problem that manufacture and a maintenance take time and effort will arise. Moreover, it is influenced by aging of coefficient of friction of friction material, operational status, temperature, etc., and the effect which it was difficult to be stabilized and to maintain the shocking absorption effect of an accumulator, and was expected is not acquired in many cases.

[0006] Furthermore, if the above-mentioned shocking absorber is attached, a mechanism will become complicated and will become an electric vehicle with few loading spaces with the composition which is not desirable.

[0007] The purpose of this invention is by controlling a generator rotational frequency beforehand to offer the hybrid vehicles which suppressed the shock at the time of engagement of an engagement means.

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MEANS

[Means for Solving the Problem] Such a purpose is attained by the following this inventions.

[0009] (1) An engine, the generator in which revolving speed control is possible, and the drive output shaft which outputs the driving force of a driving wheel, The differential gear mechanism with which the 1st gearing element was connected with the output shaft of the aforementioned engine, the 2nd gearing element was connected with Rota of the aforementioned generator, and the 3rd gearing element was connected with the aforementioned drive output shaft, The engagement means arranged between the electric motor connected with the aforementioned drive output shaft, and Rota of the aforementioned generator and a stop member, The hybrid vehicles characterized by having the engagement control means which make the aforementioned engagement means an engagement state when the relative rotational frequency of the generator control means which control the rotational frequency of the aforementioned generator, and the Rota and the aforementioned stop member which were controlled by the aforementioned generator control means becomes within limits defined beforehand.

[0010] (2) The aforementioned stop members are hybrid vehicles given in the above (1) which is the case which fixes Rota of the aforementioned generator.

[0011] (3) the aforementioned stop member -- the gearing element of the above 1st, and the gearing element of the above 3rd -- inner -- hybrid vehicles given in the above (1) which is either

[0012] (4) The above (1) which furthermore has an amendment torque amendment means for the motor output torque of the aforementioned electric motor according to torque change produced by the revolving speed control by the aforementioned generator control means, or hybrid vehicles given in either of (3).

[0013] (5) The aforementioned generator control means are hybrid vehicles the above (1) which controls the rate of change of the rotational frequency of the aforementioned generator within limits which were able to be defined beforehand, or given in either of (4).

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OPERATION

[Function] The rotational frequency of a generator is controlled by generator control means, and after dropping a rotational frequency to the rotational frequency when changing into an engagement state by the engagement means, an engagement means is made into an engagement state by engagement control means. Thereby, in between [before making an engagement means engaged, after making it engaged], since there are few differences of the rotational frequency of a generator, the shock at the time of engagement by the engagement means is suppressed.

[0015] When a stop member is a case, generator control means control the rotational frequency of a generator so that the rotational frequency of a generator serves as zero, and an engagement means is engaged. An engagement means is made engaged, when a stop member is the 1st gearing element or the 3rd gearing element and the rotational frequency of the 2nd gearing element connected to Rota of a generator becomes the same as the rotational frequency of other 1st gearing element or the 3rd gearing element. Thereby, the 1st gearing element, the 2nd gearing element, and the 3rd gearing element rotate as one.

[0016] If the rotational frequency of a generator is controlled by generator control means, the output torque outputted to a drive output shaft from a differential gear mechanism will be changed. the motor output torque of the electric motor connected with the drive output shaft here -- a torque amendment means -- change of an output torque -- responding -- an amendment -- engagement of an engagement means can be performed by things, without spoiling run feeling

[0017] Since an engine may blow the rotational frequency of a generator when making it change to the rotational frequency at the time of engagement of an engagement means and the rate of change of a rotational frequency is too large, and the same shock as a riser and the shock at the time of engagement may arise by generator control means, it is controlled so that the rate of change of a rotational frequency does not exceed within the limits defined beforehand.

[0018]

[Embodiments of the Invention]

The 1st operation gestalt of the hybrid vehicles of this invention is explained in detail based on an accompanying drawing below the <1st operation gestalt>.

[0019] Drawing 1 is the conceptual diagram showing the driving gear of the hybrid vehicles of the 1st operation gestalt of this invention. The engine output shaft 12 which outputs the rotation generated by making an engine 11 and an engine 11 drive on the 1st axis in drawing, The planetary gear unit 13 which is the differential gear mechanism which changes gears to the rotation inputted through this engine output shaft 12, The unit output shaft 14 to which the rotation after the gear change in this planetary gear unit 13 is outputted, The transfer shaft 17 which connects the 1st counter drive gear 15 fixed to this unit output shaft 14, the generator 16 which acts mainly as generators in a run state, this generator 16, and the planetary gear unit 13 is usually arranged. The unit output shaft 14 has a sleeve configuration, surrounds the engine output shaft 12 and is arranged. Moreover, the 1st counter drive gear 15 is arranged in the engine 11 side from the planetary gear unit 13.

[0020] The planetary gear unit 13 is equipped with the carrier CR which is the 1st gearing element

supported free [rotation of the starter ring R and Pinion P which are the 3rd gearing element which gears with the pinion P which gears with the sun gear S which is the 2nd gearing element, and a sun gear S, and this pinion P].

[0021] A sun gear S is connected with a generator 16 through the transfer shaft 17, a starter ring R is connected with the 1st counter drive gear 15 through the unit output shaft 14, and Carrier CR is connected with the engine 11 through the engine output shaft 12.

[0022] Furthermore, it was fixed to the transfer shaft 17 and the generator 16 is equipped with Rota 21 arranged free [rotation], the stator 22 arranged around this Rota 21, and the coil 23 around which this stator 22 was looped. A generator 16 generates power by rotation transmitted through the transfer shaft 17. It connects with the battery which is not illustrated, and the aforementioned coil 23 supplies power to this battery, and charges it.

[0023] The brake B which is an engagement means is connected to the other end side of the transfer shaft 17, by making this brake B into an engagement state, Rota 21 is fixed to a generator 16 and rotation of a generator 16 and rotation of a sun gear S are stopped. On the 2nd axis parallel to the 1st axis, the electric motor 25, the motor output shaft 26 to which rotation of an electric motor 25 is outputted, and the 2nd counter drive gear 27 fixed to the motor output shaft 26 are arranged.

[0024] It was fixed to the motor output shaft 26, and the electric motor 25 is equipped with Rota 37 arranged free [rotation], the stator 38 arranged around this Rota 37, and the coil 39 around which this stator 38 was looped. An electric motor 25 generates torque by the current supplied to a coil 39. Therefore, it connects with the battery which is not illustrated, and the coil 39 is constituted so that current may be supplied from this battery.

[0025] The hybrid vehicles of this invention generate regeneration power in response to rotation in a slowdown state from the driving wheel which an electric motor 25 does not illustrate, and this regeneration power is supplied to a battery and it charges. And in order to rotate the driving wheel which is not illustrated in the same direction as rotation of the aforementioned engine 11, on the 3rd axis parallel to the 1st axis and the 2nd axis, the counter shaft 31 is arranged as a drive output shaft. The counter driven gear 32 is being fixed to this counter shaft 31.

[0026] moreover, this counter driven gear 32, the 1st counter drive gear 15, and the counter driven gear 32 and the 2nd counter drive gear 27 make it gear -- having -- the [of the 1st counter drive gear 15 / rotation and] -- rotation of 2 counter drive gear 27 is reversed, and it is transmitted to the counter driven gear 32

[0027] Furthermore, the differential-gear pinion gear 33 with a number of teeth smaller than the counter driven gear 32 is fixed to the counter shaft 31. And the differential-gear starter ring 35 is arranged on the 4th axis parallel to the 1st axis, the 2nd axis, and the 3rd axis, and this differential-gear starter ring 35 and the aforementioned differential-gear pinion gear 33 are meshed. Moreover, differential equipment 36 is fixed to the aforementioned differential-gear starter ring 35, and by the aforementioned differential equipment 36, the rotation transmitted to the differential-gear starter ring 35 is made to carry out differential, and is transmitted to a driving wheel. The drive output system is constituted by the planetary gear unit 13, a generator 16, the 1st counter drive gear 15, the counter driven gear 32, the 2nd counter drive gear 27, the counter shaft 31, the differential-gear pinion gear 33, the differential-gear starter ring 35, and differential equipment 36 in the above-mentioned composition.

[0028] Thus, since it not only can transmit the rotation generated with the engine 11 to the counter driven gear 32, but the rotation generated by the electric motor 25 can be transmitted to the counter driven gear 32, it can be made to run hybrid vehicles in the engine motor drive mode in which the engine drive mode in which only an engine 11 is driven, the motor drive mode in which only an electric motor 25 is driven, an engine 11, and an electric motor 25 are driven. Moreover, the rotational frequency of the aforementioned transfer shaft 17 is controllable by controlling the power generated in a generator 16. Moreover, when stopping rotation of a generator, Rota 21 of charge doubling, now a generator 16 can be fixed for Brake B. In this case, by carrying out engagement release of the brake B, it can consider as the mode it runs while generating electricity with a generator 16 in the state of brake release, and can consider as the mode it runs, without generating electricity with a generator 16 in the state of brake

engagement.

[0029] Operation of the planetary gear unit 13 of the hybrid vehicles of the above-mentioned composition is explained. The velocity diagram at the time of the usual run of the planetary gear unit [in / the 1st operation gestalt of this invention / drawing 2 (A) and / in drawing 2 (B)] 13 to the conceptual diagram of the planetary gear unit 13 (drawing 1) of the 1st operation gestalt of this invention and drawing 3 are the torque diagrams at the time of a usual run of the planetary gear unit 13 in the 1st operation gestalt of this invention.

[0030] In this operation gestalt, the number of teeth of the starter ring R of the planetary gear unit 13 serves as double precision of the number of teeth of a sun gear S as shown in drawing 2 (A). Therefore, the rotational frequency of the unit output shaft 14 connected to a starter ring R (it is called a "starter-ring rotational frequency" below.) The rotational frequency of the engine output shaft 12 connected to Carrier CR (it is called a "engine speed" below.) The rotational frequency of the transfer shaft 17 which sets to NE and is connected to a sun gear S (it is called a "generator rotational frequency" below.) It is [0031] as the relation of NR, NE, and NG is shown in drawing 2 (B), when referred to as NG. $NG=3$ and $NE=2$, NR [0032] It becomes. Moreover, it is [0033] as the relation of TR, TE, and TG is shown in drawing 3 , when torque (henceforth "starter-ring torque") outputted to the unit output shaft 14 from a starter ring R is set to TR, torque (henceforth a "engine torque") of an engine 11 is set to TE and generator torque is set to TG. It is set to $TE:TR:TG=3:2:1$.

[0034] And each is rotated for a starter ring R, Carrier CR, and a sun gear S by the right direction at the time of a usual run of hybrid vehicles, and as shown in drawing 2 (B), the starter-ring rotational frequency NR (= output rotational frequency NOUT), the rotational frequency NE of an engine, and the generator rotational frequency NG all take a positive value.

[0035] And an engine torque TE is inputted into Carrier CR, and this engine torque TE can receive with the reaction force of the 1st counter drive gear 15 shown in drawing 1 , and a generator 16.

Consequently, the starter-ring torque TR is outputted to the unit output shaft 14 from a starter ring R, and the generator torque TG is outputted to the transfer shaft 17 from a sun gear S as shown in drawing 3 .

[0036] The above-mentioned starter-ring torque TR and the generator torque TG are acquired by dividing an engine torque TE proportionally by the torque ratio determined with the number of teeth of the planetary gear unit 13, and what added the starter-ring torque TR and the generator torque TG on the torque diagram serves as an engine torque TE.

[0037] Next, the control system of the hybrid vehicles of this invention is explained in detail based on the block diagram of drawing 4 . The control means which constitute the control system of this operation form have the vehicles control unit 41, an engine control system 42, motor control equipment 43, and arrangement for controlling electric generator 44. The microcomputer equipped with ROM (lead-on memory) in which CPU (central processing unit), and various programs and data were stored, RAM (random access memory) used as a working area can constitute these control units 41, 42, 43, and 44.

[0038] Furthermore, this control system is equipped with the accelerator sensor 45 which detects the accelerator opening alpha which shows the degree of demand to an operator's vehicles driving force, and the vehicle speed sensor 46 which detects the vehicle speed V. The detection value detected by each sensor 45 and 46 is supplied to the vehicles control unit 41.

[0039] The vehicles control unit 41 controls the whole hybrid vehicles, determines torque TM^* according to the vehicle speed V from the accelerator opening alpha and the vehicle speed sensor 46 from the accelerator sensor 45, makes this motor torque instruction value TM^* , and supplies it to motor control equipment 43. Moreover, amendment torque ΔTM required in order to absorb the torque change by the revolving speed control of a generator 16 by the electric motor 25 is supplied to motor control equipment 43.

[0040] Amendment torque ΔTM is computed as follows. If generator inertia is set to InG and the rotation rate of change (angular acceleration) of a generator 16 is set to βG , the sun gear torque TS which acts on a sun gear S will be set to $TS=TG+InG-\beta G$. In addition, rotation rate-of-change βG

turns into $TS=TG$, in being very small. And as mentioned later, when the number of teeth of a starter ring R is the double precision of a sun gear S, the starter-ring torque TR serves as double precision of the generator torque TG , and change torque (amendment torque) ΔTM which should be absorbed by the electric motor 25 will become $\Delta TM=2$, $i-TS=2$, and $i-(TG+InG-\beta G)$, if a counter-gear ratio is set to i .

[0041] Moreover, the vehicles control unit 41 supplies an engine ON/OFF signal to an engine control system 42. Specifically according to ON/OFF of an ignition key, an engine ON/OFF signal is supplied.

[0042] The vehicles control unit 41 supplies control-objectives rotational frequency NG^* of a generator 16 to arrangement for controlling electric generator 44. As function $NG^*=f(\alpha)$ of the accelerator opening α supplied from the accelerator sensor 45, target rotational frequency NG^* is decided as shown in drawing 5. That is, in the case of $\alpha > 20\%$ of accelerator opening, target rotational frequency NG^* is greatly decided in proportion to the accelerator opening α , and is decided to be $\alpha \leq 20\%$ of case by $NG^*=0$.

[0043] Furthermore, the vehicles control unit 41 supplies an ON/OFF signal to the electro-magnetic valve 54 which operates Brake B. The solenoid built in the electro-magnetic valve 54 based on the ON/OFF signal supplied operates, for example, when it is ON signal, a solenoid operates, a bulb is opened wide, the pressure oil from an oil pump is supplied to a brake actuator, Brake B is made into an engagement state, in the case of an OFF signal, a bulb is closed and an electro-magnetic valve 54 cancels engagement of Brake B. Engagement control means consist of a hydraulic circuit equipped with the electro-magnetic valve 54 and the brake actuator, and a vehicles control unit 41.

[0044] The vehicles control unit 41 performs the following operation, in order to suppress the shock by engagement of Brake B. In order to suppress the shock produced by engagement of Brake B, it is necessary to lessen change of the torque by engagement of Brake B, and the change torque of the generator 16 at the time of brake engagement is acquired by $\Delta TG=InG-\beta G$ like previous statement. That is, by lessening βG for rotation rate of change, the shock by brake engagement can be made small, and consumption of friction material can also be mitigated. The vehicles control unit 41 controls the generator rotational frequency NG to become a rotational frequency at the time of brake B engagement (zero), before supplying ON signal to an electro-magnetic valve 54, and it is engaged in Brake B after that. Consumption of the friction material of Brake B is not enlarged at this time, but Brake B is engaged, when making Brake B engaged is set up as a range as which ********* rotational frequency allowed value ΔNG^* was determined beforehand and absolute value $|NG|$ of a real rotational frequency becomes small from rotational frequency allowed value ΔNG^* in the range which does not tell an operator a shock. Since rotation rate-of-change βG when a rotational frequency changes from before brake B engagement to the engagement back becomes small by this, the shock at the time of brake engagement is mitigated.

[0045] An engine control system 42 is switched to the drive state (ON state) which is outputting the engine torque for the engine 11, and the state (OFF state) where the engine torque is not generated and where it does not drive, based on the selection command signal inputted from the vehicles control unit 41. Moreover, the output of an engine 11 is controlled by controlling the throttle opening θ according to the actual engine speed NE inputted from the rotational frequency sensor formed in the engine 11. This engine speed NE and the throttle opening θ are inputted also into the vehicles control unit 41.

[0046] Motor control equipment 43 controls the current (torque) IM of an electric motor 25 to become $TM=TM^*$, when amendment torque ΔTM is not supplied when amendment torque ΔTM is supplied from the vehicles control unit 41 so that it may be set to $TM=TM^*-\Delta TM$ and. Always defined torque TM^* is maintained by this, without influencing an output torque of the revolving speed control of a generator 16. A torque amendment means is constituted by the vehicles control unit 41 and motor control equipment 43.

[0047] Arrangement for controlling electric generator 44 controls the rotational frequency NG of a generator 16, and controls Current (torque) IG to become control-objectives rotational frequency NG^* inputted from the vehicles control unit 41, or control-objectives torque TG^* . Moreover, arrangement for

controlling electric generator 44 acts to the output torque TG of a generator 16 as the monitor of the real rotational frequency NG of a generator 16, and inputs the value into the vehicles control unit 41, respectively. Generator control means are constituted by the vehicles control unit 41 and arrangement for controlling electric generator 44.

[0048] Next, operation of the hybrid vehicles of this operation form constituted as mentioned above is explained. By the hybrid vehicles of this operation form, the accelerator opening alpha fixes rotation of a generator by making Brake B into an engagement state, in being small. By this, it becomes unnecessary to pass current to a generator 16, the power consumption in a generator 16 can be mitigated, and power can be saved.

[0049] Moreover, since the accelerator opening alpha becomes large [the power consumption of an electric motor 25] in being large, in proportion to the accelerator opening alpha, the rotational frequency of a generator 16 is raised by making Brake B into an open state, and the amount of power generation is made to increase. With this operation gestalt, when the accelerator opening alpha is 20% or less, Brake B is made engaged and a generator 16 is fixed, and when it is 20% or more, it generates electricity by opening Brake B wide.

[0050] Hereafter, the control action of hybrid vehicles is explained in detail. Drawing 6 is a flow chart which shows the control action of hybrid vehicles. The accelerator opening alpha is read in the accelerator sensor 45 (Step S11), and the accelerator opening alpha judges whether it is 20% or less (Step S12). When the accelerator opening alpha is 20% or less, as for the vehicles control unit 41, Brake B judges whether it is an engagement state (ON state) (Step S13). In being in an engagement state, it maintains (Step S13:Y) and a state as it is, and a return is carried out to a main routine.

[0051] When it is got blocked and the accelerator opening alpha is 20% or less, when Brake B is in a release state (OFF state), and Brake B is in a release state (Step S13: N), it judges whether rotation of a generator 16 may be fixed. That is, absolute value $|NG|$ of the generator rotational frequency NG judges whether it is below allowed value ΔNG^* (Step S14).

[0052] | In being $NG < \Delta NG^*$, (Step S14:Y) and the vehicles control unit 41 supply ON signal to an electro-magnetic valve 54, are engaged (Step S18) and carry out the return of the brake B to a main routine. A generator 16 is fixed by engagement of Brake B and the power loss in a generator 16 is suppressed.

[0053] | In being $NG \geq \Delta NG^*$, it is referred to as $NG^* = 0$ according to (Step S14:N) and drawing 5 (Step S15), and supply this to arrangement for controlling electric generator 44 (Step S16). Here, the vehicles control unit 41 acts as the monitor of the generator real rotational frequency NG through arrangement for controlling electric generator 44, and it judges whether absolute value $|NG|$ of the generator rotational frequency NG became below allowed value ΔNG^* like Step 14 (Step S17). | Repeat Step S17 until it becomes $NG < \Delta NG^*$ (Step S17: N), and by control by arrangement for controlling electric generator 44, when it becomes $NG < \Delta NG^*$ (step S17:Y), supply ON signal to an electro-magnetic valve 54, and the vehicles control unit 41 is engaged (Step S18), and carries out the return of the brake B to a main routine.

[0054] Here, in Step S16, after target rotational frequency NG^* is supplied, by the control action by which arrangement for controlling electric generator 44 turns the real rotational frequency NG to target rotational frequency NG^* , and controls it, the real rotational frequency NG is controlled in the range which does not exceed upper limit rate-of-change $\Delta NGMAX$ (rpm/sec) whose rate of change of the real rotational frequency NG is the range defined beforehand. Since the generator 16 and the engine 11 are connected through the planetary gear unit 13, when the rotational frequency NG of a generator 16 is controlled rapidly, they have an engine 11 or a possibility of having a bad influence on the amount and mpg of exhaust gas, such as blowing up. Then, the above-mentioned upper limit rate-of-change $\Delta NGMAX$ is set up as rate of change of the limitation which does not do the above-mentioned bad influence.

[0055] Drawing 7 shows upper limit rate-of-change $\Delta NGMAX$. Upper limit rate-of-change $\Delta NGMAX$ is set up so that it may become so large that the value of the accelerator opening alpha is large as illustrated. In addition, this upper limit rate-of-change $\Delta NGMAX$ is good also as constant

value, without setting up as a function of the accelerator opening α .

[0056] In Step S12, in being larger than 20%, Brake B judges [the accelerator opening α inputted at Step S11] whether it is an engagement state (ON state) (Step S19). When Brake B is in a release state (OFF state), after (Step S19:N) and the vehicles control unit 41 determine target rotational frequency NG^* of a generator 16 from the accelerator opening α (Step S20) and supply this to arrangement for controlling electric generator 44 based on drawing 5 (Step S21), the return of them is carried out to a main routine. On the other hand, when Brake B is in an engagement state, (Step S19:Y) and the vehicles control unit 41 hold the torque TG of a generator 16 to set point TG^* which becomes settled by the engine torque TE in order to hold the rotational frequency of a generator 16 (Step S22). Then, the vehicles control unit 41 supplies an OFF signal to an electro-magnetic valve 54, opens engagement of Brake B wide, and makes it a release state (OFF state) (Step S23).

[0057] Next, operation of the driving gear of the hybrid vehicles of this invention is explained based on the timing diagram shown in drawing 8. At time $t1$, it gets into an accelerator, accelerator opening changes to $\alpha 2$ from $\alpha 1$, and time $t2$ explains operation when accelerator opening changes from $\alpha 2$ to $\alpha 1$ as shown in drawing 8. Here, you may be $\alpha 1 < 20\%$, $\alpha 2 > 20\%$.

[0058] As for a generator 16, accelerator opening is fixed by engaging Brake B in the state of $\alpha 1$ (ON state), the rotational frequency has become a zero state, and the generator torque TG also serves as zero. Moreover, it is the motor [torque / motor / TM] torque $TM 1$ according to the accelerator opening $\alpha 1$. It has become.

[0059] time $t1$ the output torque corresponding to the accelerator opening $\alpha 2$ when it set and accelerator opening changed from $\alpha 1$ to $\alpha 2$ -- it should output -- the motor torque TM -- $TM 1$ from -- $TM 2$ It goes up. Brake B is in ON state at this time (a dotted line A shows drawing 8). It is below the same.

[0060] In order for the engine 11 by release of Brake B to blow and to prevent a riser, generator torque is beforehand raised to generator torque TG^* which becomes settled by the engine torque TE at that time. After becoming $TG = TG^*$, in time $t12$, Brake B is taken off (OFF) and a generator raises the generator rotational frequency NG below by the rotational frequency rate of change defined beforehand simultaneously (dotted line B). In this operation gestalt, while ordering it target rotational frequency NG^* of a generator 16, the generator torque TG is always computed and amendment torque ΔTM is added (dotted line C). For this reason, amendment torque ΔTM according to change of the generator torque TG is added to the motor torque TM as shown in drawing 8 (dotted line D).

[0061] The generator rotational frequency NG reaches target rotational frequency NG^* , without going up rapidly (dotted line E). since there is no upheaval of the generator rotational frequency NG in the meantime -- an engine 11 -- blowing up -- etc. -- a bad influence called the aggravation of mpg and the increase in an exhaust gas to depend is not produced

[0062] the attainment, simultaneously the generator 16 to target rotational frequency NG^* are controlled to hold target rotational frequency NG^* . Since elevation of the generator rotational frequency NG stops, the absolute value of the generator torque TG becomes larger than the time of the rotational frequency rising (dotted line F). If amendment torque ΔTM is added to the motor torque TM (dotted line G) and the generator rotational frequency NG also reaches target rotational frequency NG^* in the meantime, since the absolute value of the generator torque TG will become large, the motor torque TM becomes small about it at an amendment sake (dotted line H).

[0063] When accelerator opening changes to $\alpha 1$ from $\alpha 2$, the motor torque TM is $TM 2$ that the output torque according to the accelerator opening $\alpha 1$ should be outputted. Shell $TM 1$ It descends. Brake B is in the OFF state at this time (dotted line I). Next, the generator torque TG is made to increase and amendment torque ΔTM according to change of the generator torque TG is simultaneously amended to the motor torque TM to make the generator rotational frequency NG into the zero which are a rotational frequency in a brake engagement state (ON) (dotted line J). When the generator rotational frequency NG descends, without changing rapidly (dotted line K) and it becomes small rather than ΔNG^* , it is time $t22$ and Brake B is engaged (dotted line L). (ON) since there is no upheaval of the generator rotational frequency NG in the meantime -- an engine 11 -- blowing up -- etc. -- a bad

influence called the aggravation of mpg and the increase in an exhaust gas to depend is not produced [0064] since, as for the motor torque TM, torque amendment is performed (dotted line M), maintenance of run feeling is achieved and the generator torque TG becomes small with engagement of Brake B, while the generator rotational frequency NG is descending -- the motor torque TM -- the part -- it becomes large -- it becomes (dotted line N) And when a generator 16 is completely fixed by Brake B, the generator torque TG serves as zero (dotted line O).

[0065] Although the above explanation explained the control action to which the accelerator opening alpha carries out engagement release of the brake B bordering on the state of being 20% In this invention, it is not what is limited to the above-mentioned operation. by manual operation It can apply, when switching to the mode it runs while generating run mode with a generator 16, and the mode it runs, without generating electricity with a generator 16. In addition, in order to make engine brake act, when it fixes Rota 21 of a generator 16 and fixes Rota 21 of a generator 16 during a run, it can use.

[0066] In addition, what kind of brake is sufficient as the brake B used in the operation gestalt which gave [above-mentioned] explanation. In this case, although any of a wet brake and a dry type brake are sufficient, it is desirable to use a wet brake at the point which is easy to control a rotational frequency.

[0067] The <2nd operation gestalt>, next the 2nd operation gestalt of this invention are explained. Drawing 9 is the conceptual diagram showing the composition of the driving gear of the 2nd operation gestalt. By the hybrid vehicles of this operation gestalt, in the planetary gear unit 13, the clutch C which is an engagement means is formed between Carrier CR and the sun gear S, and the brake B currently arranged by the generator 16 in the 1st operation gestalt is not formed. Moreover, as for Clutch C, engagement and release are controlled by the actuator by which an ON/OFF signal is supplied from the vehicles control unit 41. About other structures, since it is the same as that of the 1st operation gestalt, the same sign is given to the same composition as drawing 1 , and explanation is omitted.

[0068] Operation of the driving gear of the 2nd operation gestalt is explained. Clutch C is usually in the release state (OFF state) at the time of a run, and is made into an engagement state (ON state) at the time of acceleration.

[0069] Usually, by the time of a run, the planetary gear unit 13 has become open, and it is rotating at the rotational frequency of which Clutch C is canceled and from which a sun gear S, Carrier CR, and a starter ring R differ independently, respectively as shown in drawing 2 (B). With the **** 2 operation form, since the number of teeth of a starter ring R serves as double precision of a sun gear S, the gear ratio of an engine 11 to the unit output shaft 14 is two thirds.

[0070] And in the time of the acceleration run with which Clutch C is engaging, each gearing element of the planetary gear unit 13 is really rotated, and becomes the same [the rotational frequency of each gearing element]. The gear ratio of an engine 11 to the unit output shaft 14 at this time is set to 1, and the output transmitted to the unit output shaft 14 from an engine 11 increases by 1.5 times as compared with the time of Clutch C being in a release state. The output transmitted to the counter shaft 31 which is a drive output shaft by this increases, and acceleration is performed.

[0071] Next, the control action of the 2nd operation form is explained. Drawing 10 is a timing diagram which shows control action. Hereafter, from the state of alpha 1, it is made to increase to alpha 2 and accelerator opening is accelerated, and control action at the time of changing the accelerator opening after an acceleration end to alpha 3 is made into an example, and it explains.

[0072] Usually, in the run state, Clutch C is in the release state (OFF state) by alpha 1, and accelerator opening is set as the value [torque / motor / TM / the rotational frequency NG of a generator 16, Torque TG, and] corresponding to the accelerator opening alpha 1 and the vehicle speed V respectively.

[0073] time t1 the output torque corresponding to the accelerator opening alpha 2 in order to set and accelerate, when accelerator opening was made to increase to alpha 2 from alpha 1 -- it should output -- the motor torque TM -- TM1 from -- TM2 It goes up. Clutch C is in the OFF state at this time (a dotted line a shows drawing 8). It is below the same.

[0074] In order to consider as the output rotational frequency NOUT into which the generator rotational frequency NG is inputted by the generator 16 at the starter ring R, it is target rotational frequency NG*2. It is set as NOUT and the generator torque TG is decreased. Thereby, the generator rotational frequency

NG is target rotational frequency NG^*2 . It turns and begins (dotted line b) to increase. To the motor torque TM , amendment torque ΔTM according to change of the generator torque TG is amended simultaneously (dotted line c). The generator rotational frequency NG rises, without changing rapidly (dotted line d), and is the real rotational frequency NG and target rotational frequency NG^*2 . When a difference becomes smaller than ΔNG^* , it is time $t12$ and Clutch C is engaged (dotted line g). (ON) Here, ΔNG^* is the real rotational frequency NG at the time of being the value set up in the range which does not enlarge consumption of the friction material of Clutch C and does not tell an operator a shock, and making Clutch C engaged, and target rotational frequency NG^*2 . It is the allowed value of a difference.

[0075] Time $t2$ If it sets, and an acceleration run is completed, accelerator opening is decreased from $\alpha 2$ to $\alpha 3$ and it is usually a run, the motor torque TM will be decreased according to the accelerator opening α (dotted line j). Moreover, in order for the engine 11 by canceling Clutch C in the state where torque is not added to a generator 16 to blow and to suppress a riser, it asks for generator torque TG^* which becomes settled by the engine torque TE at that time, and generator torque is beforehand raised to TG^* (dotted line i).

[0076] It is target rotational frequency NG^*3 so that Clutch C may be canceled in time $t22$ after becoming $TG=TG^*$ (OFF), and the generator rotational frequency NG may not exceed the upper limit of rotational frequency rate of change simultaneously. It turns and begins (dotted line k) to descend. Moreover, amendment torque ΔTM according to change of the generator torque TG is added to the motor torque TM (dotted line m). The generator rotational frequency NG is target rotational frequency NG^*3 , without descending rapidly (dotted line n). It reaches.

[0077] In addition, although any of a wet clutch and a dry clutch are sufficient as the clutch C used in the operation form which gave [above-mentioned] explanation, it is desirable to use a wet clutch at the point which can mitigate the shock at the time of engagement. By using a wet clutch, the shock at the time of clutch C engagement can be suppressed further.

[0078] Moreover, the clutch C which is the above-mentioned engagement means may be formed between the sun gear S which is the 2nd gearing element, and the starter ring R which is the 3rd gearing element, and may be prepared between Carrier CR and the starter ring R. The control method of the generator rotational frequency NG in this case is the same as that of the case of the above-mentioned 2nd operation form.

[Translation done.]

*** NOTICES ***

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the conceptual diagram showing the driving gear of the hybrid vehicles in the 1st operation gestalt of this invention.

[Drawing 2] It is the conceptual diagram and velocity diagram of a planetary gear unit in the 1st operation gestalt of this invention.

[Drawing 3] It is the torque diagram of the planetary gear unit in the 1st operation gestalt of this invention.

[Drawing 4] It is the block diagram showing the composition of the control system in the 1st operation gestalt of this invention.

[Drawing 5] It is explanatory drawing showing the relation of the target rotational frequency of hybrid vehicles and throttle opening in the 1st operation gestalt of this invention.

[Drawing 6] It is the flow chart which shows the control action of the vehicles control unit in the 1st operation gestalt of this invention.

[Drawing 7] It is explanatory drawing showing the relation of the upper limit rate of change of a generator rotational frequency and accelerator opening in the 1st operation gestalt of this invention.

[Drawing 8] It is the timing diagram which shows the control action of the vehicles control unit in the 1st operation gestalt of this invention.

[Drawing 9] It is the conceptual diagram showing the driving gear of the hybrid vehicles in the 2nd operation gestalt of this invention.

[Drawing 10] It is the timing diagram which shows the control action of the vehicles control unit in the 2nd operation gestalt of this invention.

[Description of Notations]

11 Engine

13 Planetary Gear Unit (Differential Gear Mechanism)

16 Generator

21 Rota

25 Electric Motor

31 Counter Shaft (Drive Output Shaft)

41 Vehicles Control Unit

42 Engine Control System

43 Motor Control Equipment

44 Arrangement for Controlling Electric Generator

45 Accelerator Sensor

46 Vehicle Speed Sensor

54 Electro-magnetic Valve

B Brake (engagement means)

C Clutch (engagement means)

CR Carrier (the 1st gearing element)

S Sun gear (the 2nd gearing element)
R Starter ring (the 3rd gearing element)

[Translation done.]

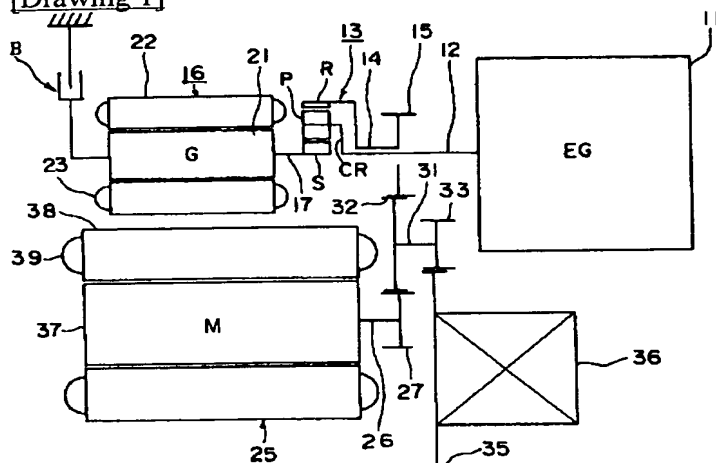
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DRAWINGS

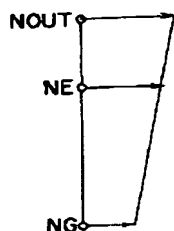
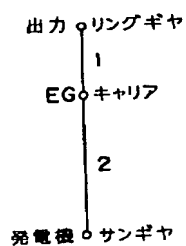
[Drawing 1]



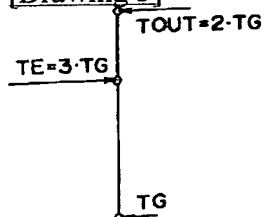
[Drawing 2]

(A)

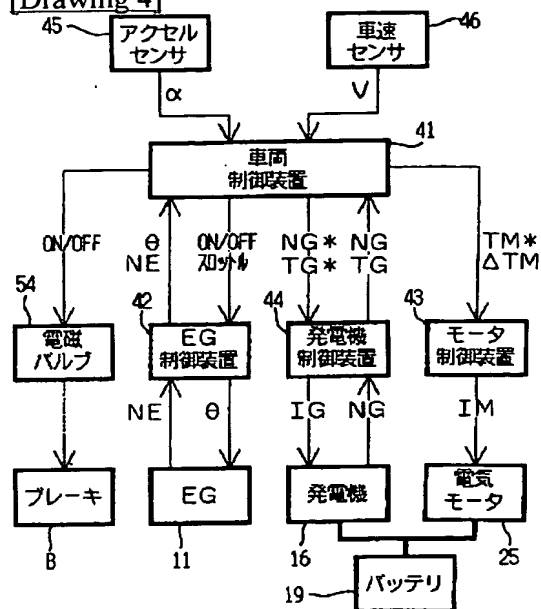
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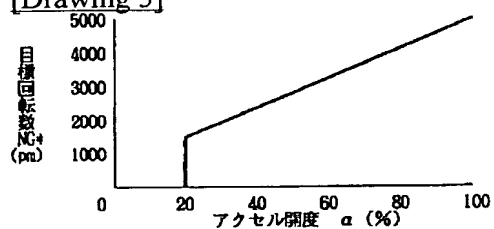
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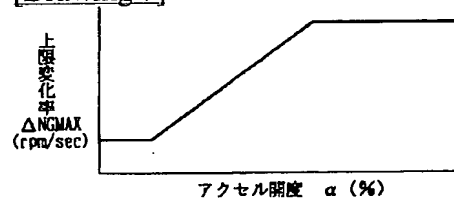
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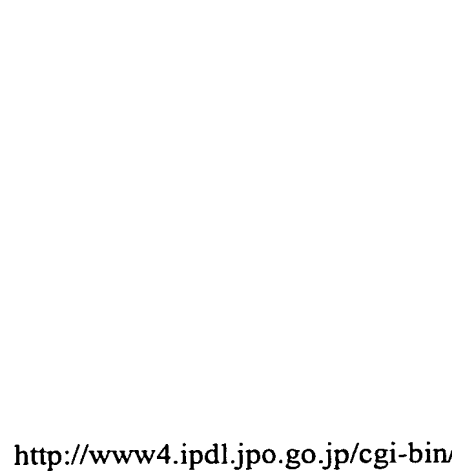
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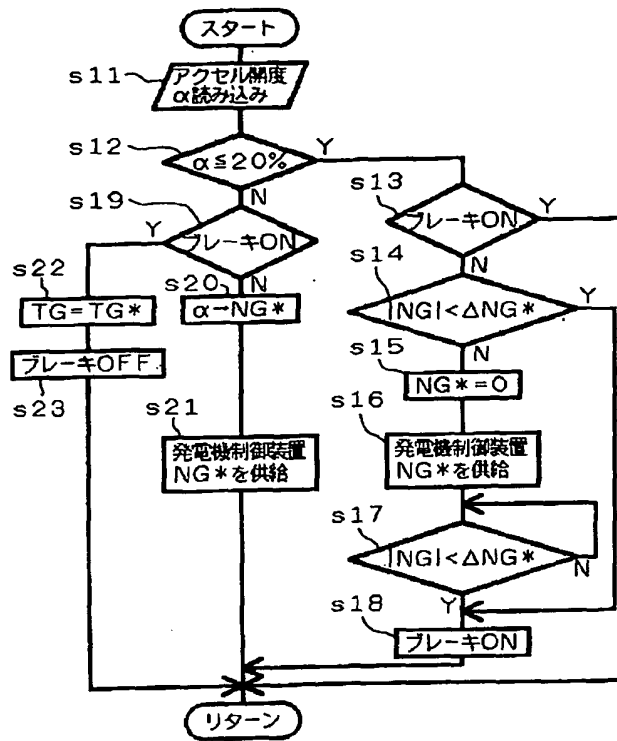


[Drawing 7]

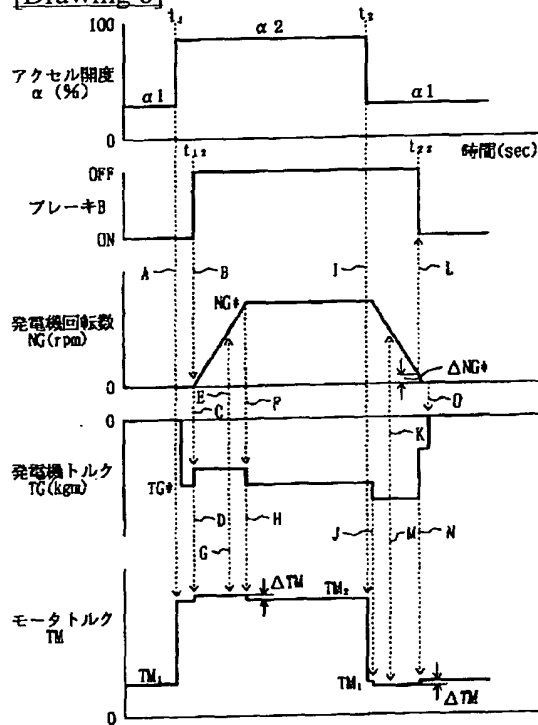


[Drawing 6]

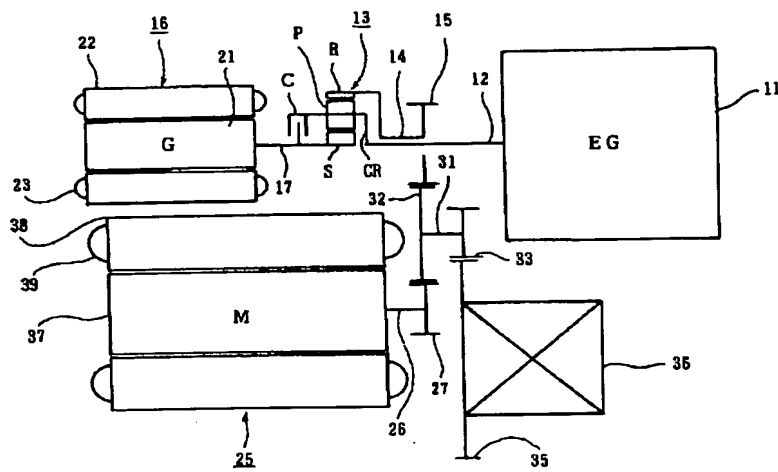




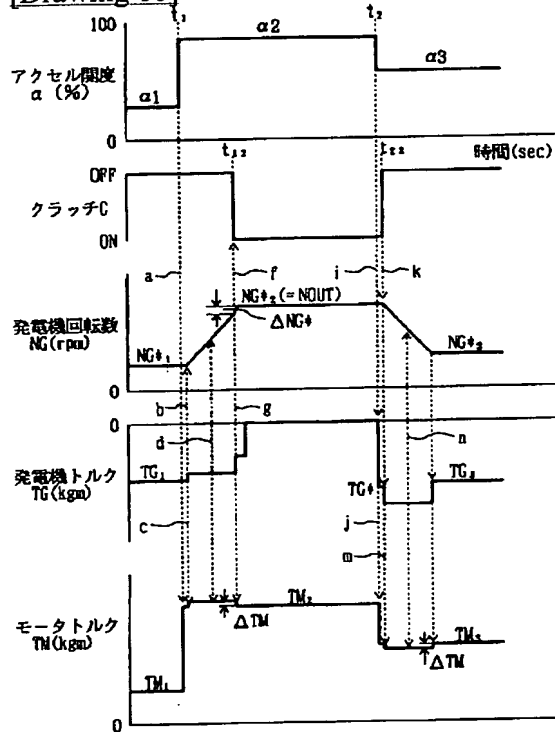
[Drawing 8]



[Drawing 9]



[Drawing 10]



[Translation done.]

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CORRECTION or AMENDMENT

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 [Date of issue] November 2, Heisei 11 (1999).

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 [Filing Number] Japanese Patent Application No. 7-344542.
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B60L	11/14	.
H02P	9/04	.

[FI]

B60K	17/04	G	.
B60L	11/14	.	.
H02P	9/04	L	.

[Procedure revision]

[Filing Date] February 9, Heisei 11.

[Procedure amendment 1]

[Document to be Amended] Specification.

[Item(s) to be Amended] Claim.

[Method of Amendment] Change.

[Proposed Amendment]

[Claim(s)]

[Claim 1] Engine,

The generator in which revolving speed control is possible,
 The drive output shaft which transmits driving force to a driving wheel,
 The electric motor connected with the aforementioned drive output shaft,
 The differential gear mechanism with which the 1st gearing element was connected with the output shaft of the aforementioned engine, the 2nd gearing element was connected with Rota of the aforementioned generator, and the 3rd gearing element was connected with the aforementioned drive output shaft,
 The engagement means arranged between Rota of the aforementioned generator, and the stop member,
 Generator control means which control the rotational frequency of the aforementioned generator,
 The hybrid vehicles characterized by having the engagement control means which make the aforementioned engagement means an engagement state when the relative rotational frequency of the

Rota and the aforementioned stop member which were controlled by the aforementioned generator control means becomes within limits defined beforehand.

[Claim 2] The aforementioned stop members are hybrid vehicles according to claim 1 which are the cases which fix Rota of the aforementioned generator.

[Claim 3] The aforementioned stop members are hybrid vehicles according to claim 1 which are either among the gearing element of the above 1st, and the gearing element of the above 3rd.

[Claim 4] The aforementioned generator control means are hybrid vehicles according to claim 1 to 3 which control the rate of change of the rotational frequency of the aforementioned generator within limits which were able to be defined beforehand.

[Procedure amendment 2]

[Document to be Amended] Specification.

[Item(s) to be Amended] 0009.

[Method of Amendment] Change.

[Proposed Amendment]

[0009] The hybrid vehicles characterized by providing the following. (1) Engine. The generator in which revolving speed control is possible. The drive output shaft which transmits driving force to a driving wheel. The electric motor connected with the aforementioned drive output shaft, and the differential gear mechanism with which the 1st gearing element was connected with the output shaft of the aforementioned engine, the 2nd gearing element was connected with Rota of the aforementioned generator, and the 3rd gearing element was connected with the aforementioned drive output shaft, The engagement means arranged between Rota of the aforementioned generator, and the stop member, and the generator control means which control the rotational frequency of the aforementioned generator, Engagement control means which make the aforementioned engagement means an engagement state when the relative rotational frequency of the Rota and the aforementioned stop member which were controlled by the aforementioned generator control means becomes within limits defined beforehand.

[Procedure amendment 3]

[Document to be Amended] Specification.

[Item(s) to be Amended] 0012.

[Method of Amendment] Deletion.

[Procedure amendment 4]

[Document to be Amended] Specification.

[Item(s) to be Amended] 0013.

[Method of Amendment] Change.

[Proposed Amendment]

[0013] (4) The aforementioned generator control means are hybrid vehicles the above (1) which controls the rate of change of the rotational frequency of the aforementioned generator within limits which were able to be defined beforehand, or given in either of (3).

[Procedure amendment 5]

[Document to be Amended] Specification.

[Item(s) to be Amended] 0032.

[Method of Amendment] Change.

[Proposed Amendment]

[0032] It becomes. moreover, when torque (henceforth "starter-ring torque") outputted to the unit output shaft 14 from a starter ring R is set to TR (=TOUT), torque (henceforth a "engine torque") of an engine 11 is set to TE and generator torque is set to TG, the relation of TR, TE, and TG is shown in drawing 3 - as

[Procedure amendment 6]

[Document to be Amended] Specification.

[Item(s) to be Amended] 0037.

[Method of Amendment] Change.

[Proposed Amendment]

[0037] Next, the control system of the hybrid vehicles of this invention is explained in detail based on the block diagram of drawing 4. The control means which constitute the control system of this operation gestalt have the vehicles control unit 41, an engine control system 42, motor control equipment 43, and arrangement for controlling electric generator 44. The microcomputer equipped with ROM (read-only memory) in which CPU (central processing unit), and various programs and data were stored, RAM (random access memory) used as a working area can constitute these control units 41, 42, 43, and 44.

[Procedure amendment 7]

[Document to be Amended] Specification.

[Item(s) to be Amended] 0076.

[Method of Amendment] Change.

[Proposed Amendment]

[0076] After becoming $TG = TG^*$, in time $t22$, Clutch C is canceled (OFF), and the generator rotational frequency NG begins (dotted line k) to descend towards target rotational frequency NG^*3 simultaneously so that the upper limit of rotational frequency rate of change may not be exceeded. Moreover, amendment torque ΔTM according to change of the generator torque TG is added to the motor torque TM (dotted line m). The generator rotational frequency NG reaches target rotational frequency NG^*3 , without descending rapidly (dotted line n). As mentioned above, if the rotational frequency of a generator is controlled by generator control means, the output torque outputted to a drive output shaft through a differential gear mechanism will be changed. the motor output torque of the electric motor connected with the drive output shaft here -- a torque amendment means -- change of an output torque -- responding -- an amendment -- engagement of an engagement means can be performed by things, without spoiling run feeling Since motor torque is amended and torque change produced at the time of generator revolving speed control is absorbed, run feeling is maintainable in the good state.

[Procedure amendment 8]

[Document to be Amended] Specification.

[Item(s) to be Amended] 0082.

[Method of Amendment] Deletion.

[Procedure amendment 9]

[Document to be Amended] Specification.

[Item(s) to be Amended] 0083.

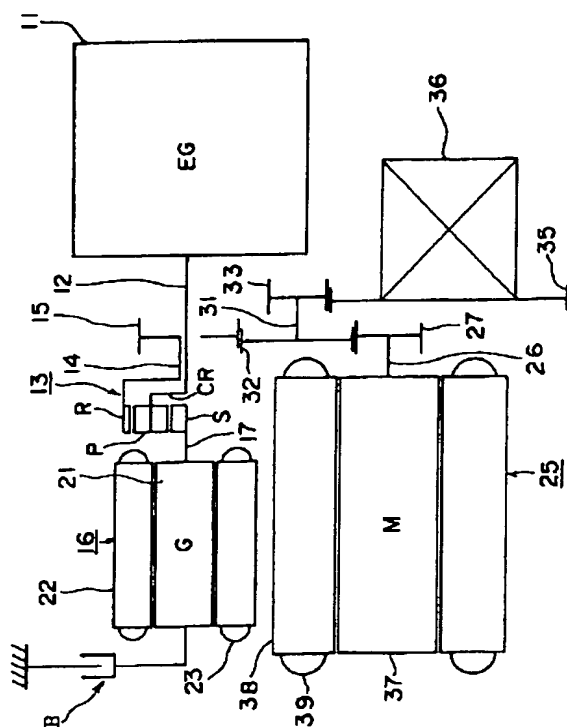
[Method of Amendment] Change.

[Proposed Amendment]

[0083] By controlling the rate of change of a generator rotational frequency within limits which were able to be defined beforehand, the abrupt change of a generator rotational frequency is suppressed and invention according to claim 4 can lessen the bad influence to mpg, the amount of exhaust gas, etc. of an engine.

[Translation done.]

Drawing selection [Representative drawing] ▾



[Translation done.]

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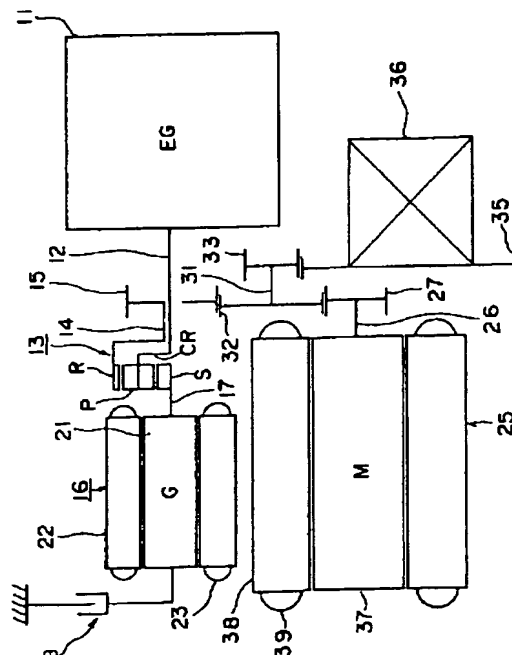
(74) 代理人 弁理士 堀 弘

(54) 【発明の名称】 ハイブリッド車両

(57) 【要約】

【課題】 発電機に設けられたブレーキの係合ショックの軽減を図る。

【解決手段】 エンジン11と発電機16と駆動出力軸31とをプラネタリギヤユニット13の各歯車要素に連結し、駆動出力軸31に連結された電気モータ25の出力とエンジン出力によって走行するハイブリッド車両において、ブレーキBによって発電機16を停止した非発電機モードと、ブレーキBを解除した発電モードとに切換走行可能な構成とし、発電機回転数をゼロに近づけてからブレーキBを係合することで、係合時ショックの軽減を図る。同時に、発電機回転数制御時のトルク変動を補正するために電気モータ25の出力トルクを調整し、かつ発電機回転数の変化率に上限を設けて、エンジン11への悪影響を少なくした。



【特許請求の範囲】

【請求項 1】 エンジンと、
回転数制御可能な発電機と、
駆動輪の駆動力を出力する駆動出力軸と、
第 1 の歯車要素が前記エンジンの出力軸に連結され、第 2 の歯車要素が前記発電機のロータに連結され、第 3 の歯車要素が前記駆動出力軸に連結された差動歯車装置と、
前記駆動出力軸に連結された電気モータと、
前記発電機のロータと係止部材との間に配設された係合手段と、
前記発電機の回転数を制御する発電機制御手段と、
前記発電機制御手段によって制御されたロータと前記係止部材との相対回転数が、予め定められた範囲内になった時に、前記係合手段を係合状態とする係合制御手段とを備えることを特徴とするハイブリッド車両。

【請求項 2】 前記係止部材は、前記発電機のロータを固定するケースである請求項 1 に記載のハイブリッド車両。

【請求項 3】 前記係止部材は、前記第 1 の歯車要素と前記第 3 の歯車要素の内いずれか一方である請求項 1 に記載のハイブリッド車両。

【請求項 4】 さらに、前記発電機制御手段による回転数制御によって生ずるトルク変動に応じて、前記電気モータのモータ出力トルクを補正するトルク補正手段を有する請求項 1 ないし 3 のいずれかに記載のハイブリッド車両。

【請求項 5】 前記発電機制御手段は、前記発電機の回転数の変化率を予め定められた範囲内に制御する請求項 1 ないし 4 のいずれかに記載のハイブリッド車両。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、エンジンとモータとを駆動源として走行するハイブリッド車両に関するものである。

【0002】

【従来の技術】従来、低公害、低燃費を実現するために、エンジンとモータとを併用した駆動装置を有するハイブリッド車両が提案されており、例えば、米国特許第 3566717 号は、差動歯車装置を用いて発電機とエンジンが連結され、エンジンからの出力の一部を発電に用い、残りを直接駆動出力軸に出力する。このようなハイブリッド車両では、発電機の回転を制御することによって、走行モードをエンジン・モータ駆動モードや、モータ駆動モードなどに切り替えることができ、さらに、回生電力のバッテリーへの充電や、エンジンの始動を行うことができる。

【0003】

【発明が解決しようとする課題】一方、上記ハイブリッド車両においては、差動歯車装置を介して、エンジン、

発電機、駆動モータが接続されており、それぞれの回転数やトルクが相互に関連するため、例えばエンジンブレーキを効かせることなどを目的として、発電機に設けられたブレーキを作用させ、発電機の回転を固定する場合がある。

【0004】ここで、ブレーキによって発電機の回転数を突然止めてしまうと、衝撃が大きくなり、走行感覚が損なわれる恐れがあり、また、ブレーキの摩擦材が発熱によって著しく消耗する。

【0005】このような衝撃を吸収するために、例えばアキュムレータのようなショック吸収装置を設けると、オリフィスやアキュムレータ・スプリングなどの調整を、車毎に行う必要があり、製造やメンテナンスに手間がかかるといった問題が生ずる。また、摩擦材の摩擦係数の経時変化や、運転状態、温度などに影響されて、アキュムレータのショック吸収効果を安定して維持することが難しく、期待した効果が得られない場合が多い。

【0006】さらに、上記ショック吸収装置を取り付けると機構が複雑となり、搭載スペースの少ない電気自動車には好ましくない構成となる。

【0007】本発明の目的は、発電機回転数を予め制御することによって、係合手段の係合時の衝撃を抑制したハイブリッド車両を提供することにある。

【0008】

【課題を解決するための手段】このような目的は、以下の本発明によって達成される。

【0009】(1) エンジンと、回転数制御可能な発電機と、駆動輪の駆動力を出力する駆動出力軸と、第 1 の歯車要素が前記エンジンの出力軸に連結され、第 2 の歯車要素が前記発電機のロータに連結され、第 3 の歯車要素が前記駆動出力軸に連結された差動歯車装置と、前記駆動出力軸に連結された電気モータと、前記発電機のロータと係止部材との間に配設された係合手段と、前記発電機の回転数を制御する発電機制御手段と、前記発電機制御手段によって制御されたロータと前記係止部材との相対回転数が、予め定められた範囲内になった時に、前記係合手段を係合状態とする係合制御手段とを備えることを特徴とするハイブリッド車両。

【0010】(2) 前記係止部材は、前記発電機のロータを固定するケースである上記 (1) に記載のハイブリッド車両。

【0011】(3) 前記係止部材は、前記第 1 の歯車要素と前記第 3 の歯車要素の内いずれか一方である上記 (1) に記載のハイブリッド車両。

【0012】(4) さらに、前記発電機制御手段による回転数制御によって生ずるトルク変動に応じて、前記電気モータのモータ出力トルクを補正するトルク補正手段を有する上記 (1) ないし (3) のいずれかに記載のハイブリッド車両。

【0013】(5) 前記発電機制御手段は、前記発電

機の回転数の変化率を予め定められた範囲内に制御する上記(1)ないし(4)のいずれかに記載のハイブリッド車両。

【0014】

【作用】発電機の回転数を発電機制御手段によって制御し、係合手段によって係合状態となった時の回転数まで回転数を落とした後、係合制御手段によって係合手段を係合状態とする。これにより、係合手段を係合させる前と、係合させた後との間で、発電機の回転数の差が少ないので、係合手段による係合時のショックが抑制される。

【0015】係止部材がケースである場合には、発電機制御手段は、発電機の回転数がゼロとなるように発電機の回転数を制御し、係合手段が係合される。係止部材が第1の歯車要素または第3の歯車要素である場合には、発電機のロータに接続された第2の歯車要素の回転数が、他の第1の歯車要素または第3の歯車要素の回転数と同じになった時に、係合手段を係合させる。これにより、第1の歯車要素、第2の歯車要素および第3の歯車要素は一体として回転する。

【0016】発電機制御手段によって発電機の回転数を制御すると、差動歯車装置から駆動出力軸に出力される出力トルクが変動する。ここで、駆動出力軸に連結されている電気モータのモータ出力トルクを、トルク補正手段により、出力トルクの変動に応じて補正することにより、走行感覚を損なうことなく、係合手段の係合ができる。

【0017】発電機制御手段によって発電機の回転数を、係合手段の係合時の回転数へ変化させる時には、回転数の変化率が大き過ぎると、エンジンの吹き上がりや、係合時のショックと同様の衝撃が生ずる可能性があるため、回転数の変化率が予め定められた範囲内を越えないように制御される。

【0018】

【発明の実施の形態】

<第1実施形態>以下、本発明のハイブリッド車両の第1実施形態について、添付図面に基づいて詳細に説明する。

【0019】図1は、本発明の第1実施形態のハイブリッド車両の駆動装置を示す概念図である。図において、第1軸線には、エンジン11と、エンジン11を駆動させることによって発生する回転を出力するエンジン出力軸12と、該エンジン出力軸12を介して入力された回転に対して変速を行う差動歯車装置であるブラネタリギヤユニット13と、該ブラネタリギヤユニット13における変速後の回転が出力されるユニット出力軸14と、該ユニット出力軸14に固定された第1カウンタドライブギヤ15と、通常走行状態では主として発電機として作用する発電機16と、該発電機16とブラネタリギヤユニット13とを連結する伝達軸17とが配置され

ている。ユニット出力軸14は、スリーブ形状を有し、エンジン出力軸12を包囲して配設されている。また、第1カウンタドライブギヤ15は、ブラネタリギヤユニット13よりエンジン11側に配設されている。

【0020】ブラネタリギヤユニット13は、第2の歯車要素であるサンギヤSと、サンギヤSと噛合するピニオンPと、該ピニオンPと噛合する第3の歯車要素であるリングギヤRと、ピニオンPを回転自在に支持する第1の歯車要素であるキャリアCRとを備えている。

【0021】サンギヤSは、伝達軸17を介して発電機16と連結され、リングギヤRは、ユニット出力軸14を介して第1カウンタドライブギヤ15と連結され、キャリアCRは、エンジン出力軸12を介してエンジン11と連結されている。

【0022】さらに、発電機16は伝達軸17に固定され、回転自在に配設されたロータ21と、該ロータ21の周囲に配設されたステータ22と、該ステータ22に巻装されたコイル23とを備えている。発電機16は、伝達軸17を介して伝達される回転によって電力を発生させる。前記コイル23は図示しないバッテリーに接続され、該バッテリーに電力を供給して充電する。

【0023】発電機16には、伝達軸17の他端側に、係合手段であるブレーキBが接続されており、このブレーキBを係合状態とすることで、ロータ21が固定され、発電機16の回転およびサンギヤSの回転が停止されるようになっている。第1軸線と平行な第2軸線上には、電気モータ25と、電気モータ25の回転が出力されるモータ出力軸26と、モータ出力軸26に固定された第2カウンタドライブギヤ27とが配置されている。

【0024】電気モータ25は、モータ出力軸26に固定され、回転自在に配設されたロータ37と、該ロータ37の周囲に配設されたステータ38と、該ステータ38に巻装されたコイル39とを備えている。電気モータ25は、コイル39に供給される電流によってトルクを発生させる。そのために、コイル39は図示しないバッテリーに接続され、該バッテリーから電流が供給されるように構成されている。

【0025】本発明のハイブリッド車両が減速状態において、電気モータ25は、図示しない駆動輪から回転を受けて再生電力を発生させ、該再生電力をバッテリーに供給して充電する。そして、前記エンジン11の回転と同じ方向に図示しない駆動輪を回転させるために、第1軸線及び第2軸線と平行な第3軸線には、駆動出力軸としてカウンタシャフト31が配設されている。該カウンタシャフト31にはカウンタドリブンギヤ32が固定されている。

【0026】また、該カウンタドリブンギヤ32と第1カウンタドライブギヤ15とが、及びカウンタドリブンギヤ32と第2カウンタドライブギヤ27とが噛合させられ、第1カウンタドライブギヤ15の回転及び第2カ

ウンタドライブギヤ27の回転が反転されてカウンタドリブンギヤ32に伝達されるようになっている。

【0027】さらに、カウンタシャフト31には、カウンタドリブンギヤ32より歯数が小さなデフビニオンギヤ33が固定される。そして、第1軸線、第2軸線及び第3軸線に平行な第4軸線上にデフリングギヤ35が配設され、該デフリングギヤ35と前記デフビニオンギヤ33とが噛み合わせられる。また、前記デフリングギヤ35にディファレンシャル装置36が固定され、デフリングギヤ35に伝達された回転が前記ディファレンシャル装置36によって差動させられ、駆動輪に伝達される。上記構成において、駆動出力系は、ブラネタリギヤユニット13と、発電機16と、第1カウンタドライブギヤ15と、カウンタドリブンギヤ32と、第2カウンタドライブギヤ27と、カウンタシャフト31と、デフビニオンギヤ33と、デフリングギヤ35と、ディファレンシャル装置36とによって構成されている。

【0028】このように、エンジン11によって発生させられた回転をカウンタドリブンギヤ32に伝達することができるだけでなく、電気モータ25によって発生させられた回転をカウンタドリブンギヤ32に伝達することができるので、エンジン11だけを駆動するエンジン駆動モード、電気モータ25だけを駆動するモータ駆動モード、並びにエンジン11及び電気モータ25を駆動するエンジン・モータ駆動モードでハイブリッド車両を走行させることができる。また、発電機16において発生させられる電力を制御することによって、前記伝達軸17の回転数を制御することができる。また、発電機の回転を停止させる場合には、ブレーキBを係合させて発電機16のロータ21を固定することができる。この場合、ブレーキBを係合解除することによって、ブレーキ解除状態では発電機16で発電しながら走行するモードとし、ブレーキ係合状態では発電機16で発電せずに走行するモードとすることができる。

【0029】上記構成のハイブリッド車両のブラネタリギヤユニット13の動作について説明する。図2(A)は、本発明の第1実施形態のブラネタリギヤユニット13(図1)の概念図、図2(B)は、本発明の第1実施形態におけるブラネタリギヤユニット13の通常走行時の速度線図、図3は、本発明の第1実施形態におけるブラネタリギヤユニット13の通常走行時のトルク線図である。

【0030】本実施形態においては、図2(A)に示されているように、ブラネタリギヤユニット13のリングギヤRの歯数がサンギヤSの歯数の2倍となっている。従って、リングギヤRに接続されるユニット出力軸14の回転数(以下「リングギヤ回転数」という。)をNRとし、キャリアCRに接続されるエンジン出力軸12の回転数(以下「エンジン回転数」という。)をNEとし、サンギヤSに接続される伝達軸17の回転数(以下

「発電機回転数」という。)をNGとした時、NR、NE、NGの関係は、図2(B)に示されているように、

$$【0031】NG = 3 \cdot NE - 2 \cdot NR$$

【0032】となる。また、リングギヤRからユニット出力軸14に出力されるトルク(以下「リングギヤトルク」という。)をTRとし、エンジン11のトルク(以下「エンジントルク」という。)をTEとし、発電機トルクをTGとしたとき、TR、TE、TGの関係は、図3に示されているように、

$$【0033】TE : TR : TG = 3 : 2 : 1 \text{ となる。}$$

【0034】そして、ハイブリッド車両の通常走行時においては、リングギヤR、キャリアCRおよびサンギヤSは、いずれも正方向に回転させられ、図2(B)に示されるように、リングギヤ回転数NR(=出力回転数NOUT)、エンジンの回転数NE、発電機回転数NGは、いずれも正の値を採る。

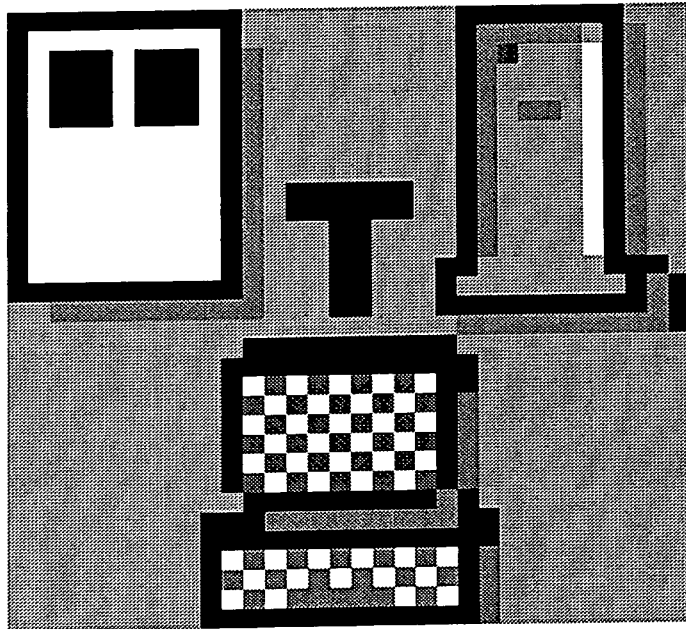
【0035】そして、エンジントルクTEが、キャリアCRに入力され、このエンジントルクTEが、図1に示されている第1カウンタドライブギヤ15および発電機16の反力によって受けられる。その結果、図3に示されているように、リングギヤRからユニット出力軸14にリングギヤトルクTRが、サンギヤSから伝達軸17に発電機トルクTGが出力される。

【0036】上記リングギヤトルクTRおよび発電機トルクTGは、ブラネタリギヤユニット13の歯数によって決定されるトルク比でエンジントルクTEを按分することによって得られ、トルク線図上において、リングギヤトルクTRと発電機トルクTGとを加えたものがエンジントルクTEとなる。

【0037】次に、本発明のハイブリッド車両の制御系について、図4のブロック図に基づいて詳細に説明する。本実施形態の制御系を構成する制御手段は、車両制御装置41と、エンジン制御装置42と、モータ制御装置43と、発電機制御装置44とを有している。これらの制御装置41、42、43、44は、例えばCPU(中央処理装置)、各種プログラムやデータが格納されたROM(リード・オン・メモリ)、ワーキングエリアとして使用されるRAM(ランダム・アクセス・メモリ)等を備えたマイクロコンピュータによって構成することができる。

【0038】さらに、この制御系は、運転者の車両駆動力への要求度を示すアクセル開度 α を検出するアクセルセンサ45と、車速Vを検出する車速センサ46とを備えている。それぞれのセンサ45、46で検出された検出値は車両制御装置41へ供給される。

【0039】車両制御装置41は、ハイブリッド車両の全体を制御するもので、アクセルセンサ45からのアクセル開度 α と、車速センサ46からの車速Vに応じたトルクTM*を決定し、これをモータトルク指令値TM*としてモータ制御装置43へ供給する。また、発電機1



る時に、ブレーキBを開放して発電を行う。

【0050】以下、ハイブリッド車両の制御動作について詳細に説明する。図6は、ハイブリッド車両の制御動作を示す、フローチャートである。アクセルセンサ45からアクセル開度 α を読み取り（ステップS11）、アクセル開度 α が20%以下か否かを判断する（ステップS12）。アクセル開度 α が20%以下である場合には、車両制御装置41は、ブレーキBが係合状態（ON状態）か否かを判断する（ステップS13）。係合状態である場合には（ステップS13：Y）、そのままの状態を維持し、メインルーチンへリターンする。

【0051】ブレーキBが解除状態（OFF状態）である場合には、つまり、アクセル開度 α が20%以下であり、かつブレーキBが解除状態である場合（ステップS13：N）には、発電機16の回転を固定しても良いか否かを判断する。即ち、発電機回転数NGの絶対値 $|NG|$ が、許容値 ΔNG^* 以下であるか否かを判断する（ステップS14）。

【0052】 $|NG| < \Delta NG^*$ である場合には（ステップS14：Y）、車両制御装置41は、電磁バルブ54にON信号を供給してブレーキBを係合し（ステップS18）、メインルーチンにリターンする。ブレーキBの係合によって、発電機16が固定され、発電機16における電力ロスが抑制される。

【0053】 $|NG| \geq \Delta NG^*$ である場合には（ステップS14：N）、図5に従って $NG^* = 0$ とし（ステップS15）、これを発電機制御装置44へ供給する（ステップS16）。ここで、車両制御装置41は、発電機制御装置44を介して、発電機実回転数NGをモニターし、ステップ14と同様に、発電機回転数NGの絶対値 $|NG|$ が、許容値 ΔNG^* 以下となったか否かを判断する（ステップS17）。 $|NG| < \Delta NG^*$ となるまでステップS17を繰り返し（ステップS17：N）、発電機制御装置44による制御によって、 $|NG| < \Delta NG^*$ となった時（ステップS17：Y）、車両制御装置41は、電磁バルブ54にON信号を供給してブレーキBを係合し（ステップS18）、メインルーチンにリターンする。

【0054】ここで、ステップS16において、目標回転数 NG^* が供給された後、発電機制御装置44が、実回転数NGを目標回転数 NG^* へ向けて制御する制御動作では、実回転数NGの変化率が、予め定められた範囲である上限変化率 $\Delta NGMAX$ （rpm/sec）を越えない範囲で実回転数NGが制御される。発電機16とエンジン11は、プラネタリギヤユニット13を介して連結されているため、発電機16の回転数NGを急激に制御すると、エンジン11が吹き上がるなど、排気ガスの量や燃費に悪影響を及ぼす恐れがある。そこで、上記上限変化率 $\Delta NGMAX$ は、上記悪影響を及ぼさない限界の変化率として設定されている。

【0055】図7は、上限変化率 $\Delta NGMAX$ を示すものである。図示されているように、上限変化率 $\Delta NGMAX$ はアクセル開度 α の値が大きいくらい大きくなるように設定されている。なお、この上限変化率 $\Delta NGMAX$ は、アクセル開度 α の関数として設定せずに、一定値としてもよい。

【0056】ステップS12において、ステップS11で入力したアクセル開度 α が20%より大きい場合には、ブレーキBが係合状態（ON状態）か否かを判断する（ステップS19）。ブレーキBが解除状態（OFF状態）である場合には（ステップS19：N）、車両制御装置41は、図5に基づいて、アクセル開度 α から発電機16の目標回転数 NG^* を決定し（ステップS20）、これを発電機制御装置44へ供給した後（ステップS21）、メインルーチンにリターンする。一方、ブレーキBが係合状態である場合には（ステップS19：Y）、車両制御装置41は、発電機16の回転数を保持するため、発電機16のトルクTGをエンジントルクTEによって定まる設定値 TG^* に保持する（ステップS22）。その後、車両制御装置41は、電磁バルブ54にOFF信号を供給し、ブレーキBの係合を開放し解除状態（OFF状態）とする（ステップS23）。

【0057】次に、本発明のハイブリッド車両の駆動装置の動作について、図8に示されているタイムチャートに基づいて説明する。図8に示されているように、時刻 t_1 で、アクセルが踏み込まれて、アクセル開度が α_1 から α_2 へ変化し、時刻 t_2 で、アクセル開度が α_2 から α_1 へ変化した場合の動作について説明する。ここで、 $\alpha_1 < 20\%$ 、 $\alpha_2 > 20\%$ とする。

【0058】アクセル開度が α_1 の状態では、ブレーキBは係合（ON状態）され、発電機16は固定されて、回転数がゼロの状態となっており、発電機トルクTGもゼロとなっている。また、モータトルク TM は、アクセル開度 α_1 に応じたモータトルク TM_1 となっている。

【0059】時刻 t_1 において、アクセル開度が α_1 から α_2 へ変化すると、アクセル開度 α_2 に応じた出力トルクを出力すべくモータトルク TM は、 TM_1 から TM_2 へ上昇する。この時、ブレーキBはON状態となっている（図8において点線Aで示す。以下同じ）。

【0060】ブレーキBの解除によるエンジン11の吹き上がりを防止するために、その時のエンジントルクTEによって定まる発電機トルク TG^* に、発電機トルクを予め上昇させる。 $TG = TG^*$ となった後、時刻 t_{12} において、ブレーキBを解除（OFF）し、同時に発電機は、予め定められた回転数変化率以下で発電機回転数NGを上昇させる（点線B）。本実施形態においては、発電機16の目標回転数 NG^* を指令している時に、常に発電機トルクTGを算出して補正トルク ΔTM をくわえることにしている（点線C）。このため、図8に示されているように、モータトルク TM には、発電機トルク

TGの変動に応じた補正トルク ΔTM が加えられる(点線D)。

【0061】発電機回転数NGは、急激に上昇することなく(点線E)、目標回転数NG*に到達する。この間、発電機回転数NGの激変がないため、エンジン11には、吹き上がりなどによる燃費の悪化や排出ガスの増加といった悪影響は生じない。

【0062】目標回転数NG*への到達と同時に、発電機16は目標回転数NG*を保持するように制御される。発電機回転数NGの上昇が止まるので、発電機トルクTGの絶対値は回転数が上昇している時よりも大きくなる(点線F)。この間にもモータトルクTMには、補正トルク ΔTM が加えられており(点線G)、発電機回転数NGが目標回転数NG*に到達すると、発電機トルクTGの絶対値が大きくなるので、それを補正するためにモータトルクTMは小さくなる(点線H)。

【0063】アクセル開度が $\alpha 2$ から $\alpha 1$ へ変化すると、アクセル開度 $\alpha 1$ に応じた出力トルクを出力すべくモータトルクTMは、 TM_2 から TM_1 へ下降する。この時、ブレーキBはOFF状態となっている(点線I)。次に、発電機回転数NGをブレーキ係合状態(ON)での回転数であるゼロにするべく、発電機トルクTGを増加させ、同時にモータトルクTMに対しては、発電機トルクTGの変動に応じた補正トルク ΔTM が補正される(点線J)。発電機回転数NGは、急激に変化することなく下降し(点線K)、 ΔNG *よりも小さくなった時に、時刻 t_{12} で、ブレーキBが係合(ON)される(点線L)。この間、発電機回転数NGの激変がないため、エンジン11には、吹き上がりなどによる燃費の悪化や排出ガスの増加といった悪影響は生じない。

【0064】発電機回転数NGが下降している間、モータトルクTMはトルク補正が行われており(点線M)、走行感覚の維持が図られており、ブレーキBの係合とともに、発電機トルクTGが小さくなるのでモータトルクTMはその分大きくなる(点線N)。そして、ブレーキBによって発電機16が完全に固定された時に、発電機トルクTGがゼロとなる(点線O)。

【0065】以上の説明は、アクセル開度 α が20%である状態を境として、ブレーキBを係合解除する制御動作について説明したが、本発明においては、上記動作に限定されるものではなく、マニュアル操作によって、走行モードを発電機16で発電しながら走行するモードと、発電機16で発電せずに走行するモードとに切り換える場合にも適用でき、その他、エンジンブレーキを作用させるために発電機16のロータ21を固定する場合など、走行中に発電機16のロータ21を固定する場合に用いることができる。

【0066】なお、上記説明した実施形態において用いられるブレーキBはいかなる種類のブレーキでもよい。この場合、湿式ブレーキ、乾式ブレーキのいずれでもよ

いが、回転数を制御しやすい点で湿式ブレーキを用いることが好ましい。

【0067】<第2実施形態>次に、本発明の第2実施形態について説明する。図9は、第2実施形態の駆動装置の構成を示す概念図である。本実施形態のハイブリッド車両では、プラネタリギヤユニット13において、キャリアCRとサンギヤSとの間に係合手段であるクラッチCが設けられており、第1実施形態において発電機16に配設されていたブレーキBは設けられていない。また、クラッチCは、車両制御装置41からON/OFF信号が供給されるアクチュエータによって係合と解除が制御される。その他の構造については、第1実施形態と同様であるので、図1と同一構成に同一符号を付し、説明を省略する。

【0068】第2実施形態の駆動装置の動作について説明する。クラッチCは、通常走行時においては、解除状態(OFF状態)となっており、加速時において、係合状態(ON状態)とされる。

【0069】クラッチCが解除されている通常走行時には、プラネタリギヤユニット13はオープンとなっており、図2(B)に示されているように、サンギヤS、キャリアCR、リングギヤRがそれぞれ独立して異なる回転数で回転している。本第2実施形態では、リングギヤRの歯数がサンギヤSの2倍となっているから、ユニット出力軸14に対するエンジン11のギヤ比は、2/3となっている。

【0070】そして、クラッチCが係合されている加速走行時には、プラネタリギヤユニット13の各歯車要素は、一体回転となり各歯車要素の回転数は同一となる。この時のユニット出力軸14に対するエンジン11のギヤ比は1となり、クラッチCが解除状態である時に比較して、エンジン11からユニット出力軸14に伝達される出力が1.5倍に増大する。これにより、駆動出力軸であるカウンタシャフト31に伝達される出力が増大し、加速が行われる。

【0071】次に、第2実施形態の制御動作について説明する。図10は、制御動作を示すタイムチャートである。以下、アクセル開度を $\alpha 1$ の状態から、 $\alpha 2$ へ増加させて加速し、加速終了後アクセル開度を $\alpha 3$ へ変化させた場合の制御動作を例にして説明する。

【0072】通常走行状態では、アクセル開度が $\alpha 1$ で、クラッチCは解除状態(OFF状態)となっており、発電機16の回転数NG、トルクTGおよびモータトルクTMは、それぞれアクセル開度 $\alpha 1$ および車速Vに応じた値に設定されている。

【0073】時刻 t_1 において、加速するためにアクセル開度を $\alpha 1$ から $\alpha 2$ へ増加させると、アクセル開度 $\alpha 2$ に応じた出力トルクを出力すべくモータトルクTMは、 TM_2 から TM_1 へ上昇する。この時、クラッチCはOFF状態となっている(図8において点線aで示

す。以下同じ)。

【0074】発電機16には、発電機回転数NGをリングギヤRに入力されている出力回転数NOUTとするために、目標回転数NG*₂をNOUTに設定し、発電機トルクTGを減少させる。これにより、発電機回転数NGが目標回転数NG*₂へ向けて増加し始める(点線b)。同時にモータトルクTMに対しては、発電機トルクTGの変動に応じた補正トルクΔTMが補正される(点線c)。発電機回転数NGは、急激に変化することなく上昇し(点線d)、実回転数NGと目標回転数NG*₂との差がΔNG*よりも小さくなった時に、時刻t₁₂で、クラッチCが係合(ON)される(点線g)。ここで、ΔNG*は、クラッチCの摩擦材の消耗を大きくせず、運転者にショックを伝えない範囲で設定される値で、クラッチCを係合させる時の、実回転数NGと目標回転数NG*₂との差の許容値である。

【0075】時刻t₁において、加速走行が終了してアクセル開度をα₂からα₃へ減少させ、通常走行とすると、アクセル開度αに応じてモータトルクTMを減少させる(点線j)。また、発電機16にトルクを加えない状態ではクラッチCを解除することによるエンジン11の吹き上がりを抑制するために、その時のエンジントルクTEによって定まる発電機トルクTG*を求め、TG*まで発電機トルクを予め上昇させる(点線i)。

【0076】TG=TG*となった後、時刻t₁₂において、クラッチCが解除(OFF)され、同時に発電機回転数NGは、回転数変化率の上限を越えないように目標回転数NG*₂へ向けて下降し始める(点線k)。また、モータトルクTMには、発電機トルクTGの変動に応じた補正トルクΔTMが加えられる(点線m)。発電機回転数NGは、急激に下降することなく(点線n)、目標回転数NG*₂に到達する。

【0077】なお、上記説明した実施形態において用いられるクラッチCは、湿式クラッチ、乾式クラッチのいずれでもよいが、係合時のショックを軽減できる点で湿式クラッチを用いることが好ましい。湿式クラッチを用いることで、クラッチC係合時のショックをより一層抑制することができる。

【0078】また、上記係合手段であるクラッチCは、第2の歯車要素であるサンギヤSと第3の歯車要素であるリングギヤRとの間に設けられていてもよく、また、キャリアCRとリングギヤRとの間に設けられていてもよい。この場合の、発電機回転数NGの制御方法は、上記第2実施形態の場合と同様である。

【0079】

【発明の効果】以上説明した請求項1に記載の発明は、係合手段を係合させる前と、係合させた後との間で、発電機の回転数の差が少なくなるので、係合手段による係合時のショックが抑制される。これにより、係合手段の耐久性が向上し、特に、摩擦材が受ける熱負荷が軽減さ

れるため、摩擦材の耐久性が著しく向上する。また、係合時の衝撃を緩衝するアキュムレータ等の装置が不要となるので、駆動機構の簡略化と軽量化が実現できるとともに、緩衝装置のチューニング等が不要となる。さらに、摩擦材の経時変化や運転状態、温度の変化などから悪影響を受けることが少ないので、安定した衝撃抑制効果が継続して得られる。

【0080】請求項2に記載の発明は、発電走行から非発電走行へ切り換える際の、発電機ロータ固定による衝撃を抑制することができる。

【0081】請求項3に記載の発明は、例えば、通常走行から加速走行へ移る時のクラッチ係合による衝撃を抑制することができる。

【0082】請求項4に記載の発明は、発電機回転数制御時に生ずるトルク変動を、モータトルクを補正して吸収するため、走行感覚を良好な状態に維持することができる。

【0083】請求項5に記載の発明は、発電機回転数の変化率を予め定められた範囲内に制御することで、発電機回転数の急激な変化が抑制され、エンジンの燃費や排ガス量等に対する悪影響を少なくすることができる。

【図面の簡単な説明】

【図1】本発明の第1実施形態におけるハイブリッド車両の駆動装置を示す概念図である。

【図2】本発明の第1実施形態におけるブラネタリギヤユニットの概念図および速度線図である。

【図3】本発明の第1実施形態におけるブラネタリギヤユニットのトルク線図である。

【図4】本発明の第1実施形態における制御系の構成を示すブロック図である。

【図5】本発明の第1実施形態におけるハイブリッド車両の目標回転数とスロットル開度との関係を示す説明図である。

【図6】本発明の第1実施形態における車両制御装置の制御動作を示すフローチャートである。

【図7】本発明の第1実施形態における発電機回転数の上限変化率とアクセル開度との関係を示す説明図である。

【図8】本発明の第1実施形態における車両制御装置の制御動作を示すタイムチャートである。

【図9】本発明の第2実施形態におけるハイブリッド車両の駆動装置を示す概念図である。

【図10】本発明の第2実施形態における車両制御装置の制御動作を示すタイムチャートである。

【符号の説明】

11	エンジン
13	ブラネタリギヤユニット(差動歯車装置)
16	発電機
21	ロータ

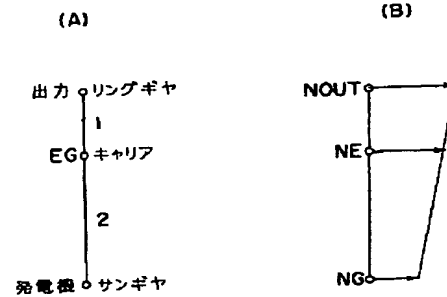
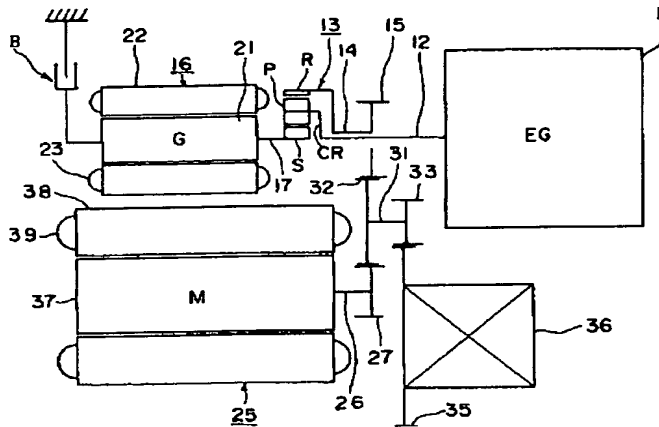
(9)

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25	電気モータ	*46	車速センサ
31	カウンタシャフト（駆動出力軸）	54	電磁バルブ
41	車両制御装置	B	ブレーキ（係合手段）
42	エンジン制御装置	C	クラッチ（係合手段）
43	モータ制御装置	CR	キャリア（第1歯車要素）
44	発電機制御装置	S	サンギヤ（第2歯車要素）
45	アクセルセンサ	*R	リングギヤ（第3歯車要素）

【図1】

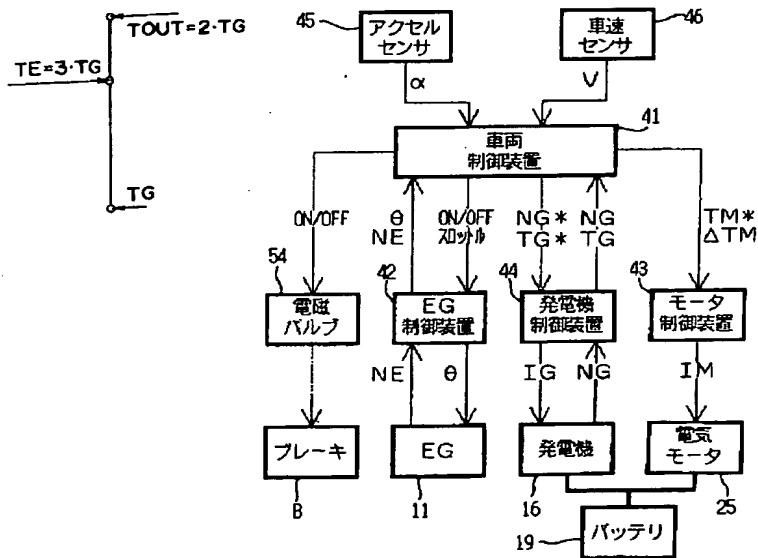
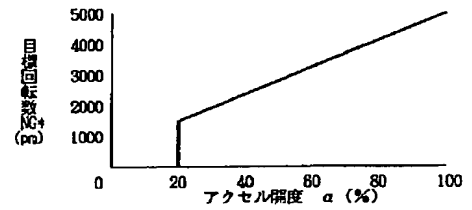
【図2】



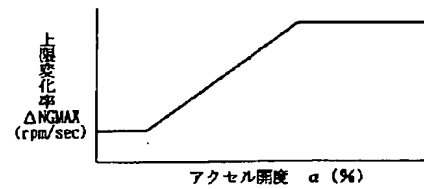
【図5】

【図3】

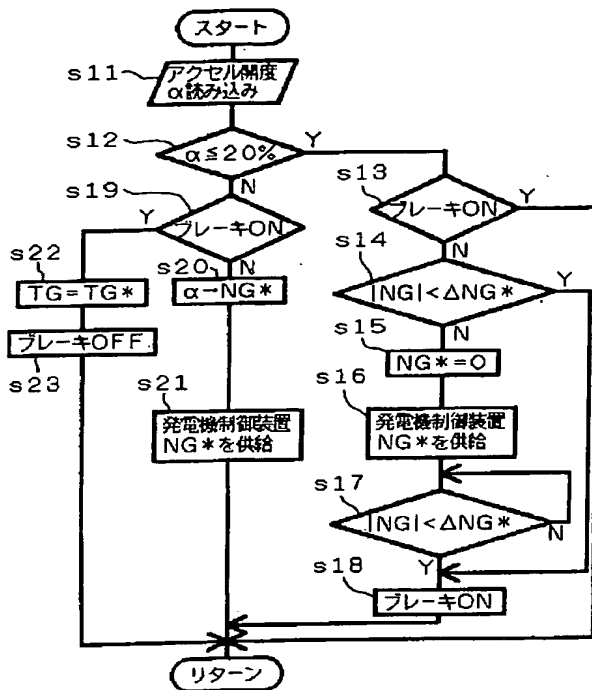
【図4】



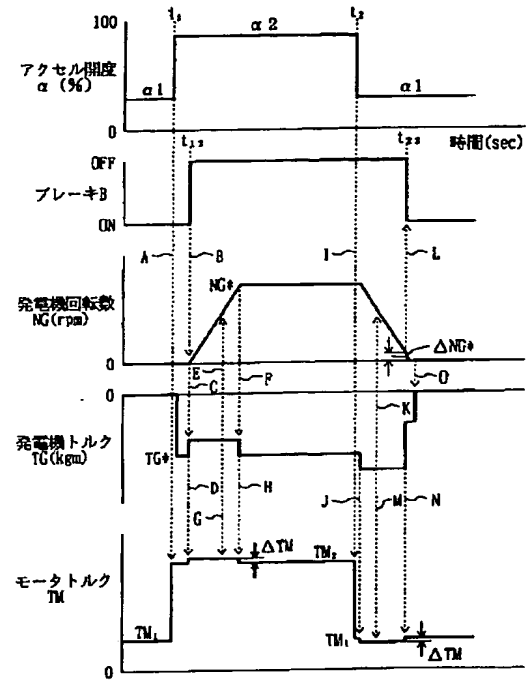
【図7】



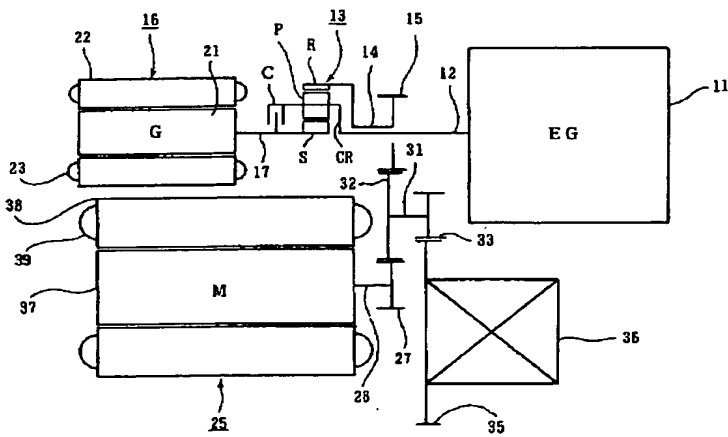
【図6】



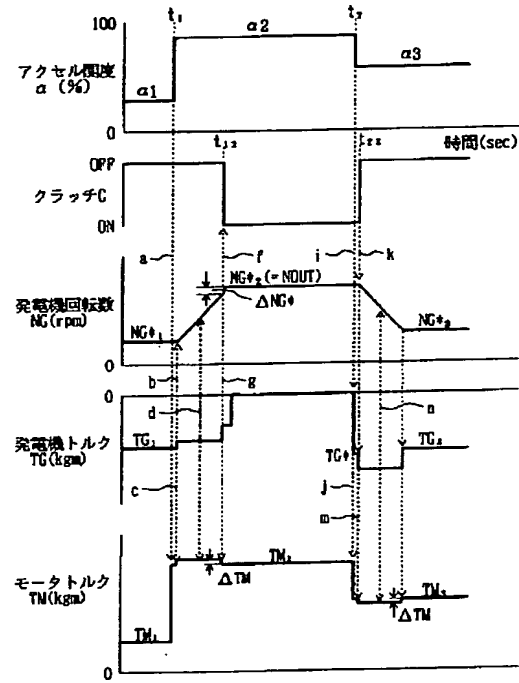
【図8】



【図9】



【図10】



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【手続補正書】

【提出日】平成 11 年 2 月 9 日

【手続補正 1】

【補正対象書類名】明細書

【補正対象項目名】特許請求の範囲

【補正方法】変更

【補正内容】

【特許請求の範囲】

【請求項 1】 エンジンと、
 回転数制御可能な発電機と、
 駆動輪へ駆動力を伝達する駆動出力軸と、
 前記駆動出力軸に連結された電気モータと、
 第 1 の歯車要素が前記エンジンの出力軸に連結され、第 2 の歯車要素が前記発電機のロータに連結され、第 3 の歯車要素が前記駆動出力軸に連結された差動歯車装置と、
 前記発電機のロータと係止部材との間に配設された係合手段と、
 前記発電機の回転数を制御する発電機制御手段と、
 前記発電機制御手段によって制御されたロータと前記係止部材との相対回転数が、予め定められた範囲内になったときに、前記係合手段を係合状態とする係合制御手段とを備えることを特徴とするハイブリッド車両。

【請求項 2】 前記係止部材は、前記発電機のロータを固定するケースである請求項 1 に記載のハイブリッド車両。

【請求項 3】 前記係止部材は、前記第 1 の歯車要素と前記第 3 の歯車要素の内いずれか一方である請求項 1 に記載のハイブリッド車両。

【請求項 4】 前記発電機制御手段は、前記発電機の回転数の変化率を予め定められた範囲内に制御する請求項 1 ないし 3 のいずれかに記載のハイブリッド車両。

【手続補正 2】

【補正対象書類名】明細書

【補正対象項目名】0009

【補正方法】変更

【補正内容】

【0009】（1） エンジンと、回転数制御可能な発電機と、駆動輪へ駆動力を伝達する駆動出力軸と、前記駆動出力軸に連結された電気モータと、第 1 の歯車要素が前記エンジンの出力軸に連結され、第 2 の歯車要素が前記発電機のロータに連結され、第 3 の歯車要素が前記駆動出力軸に連結された差動歯車装置と、前記発電機のロータと係止部材との間に配設された係合手段と、前記発電機の回転数を制御する発電機制御手段と、前記発電機制御手段によって制御されたロータと前記係止部材との相対回転数が、予め定められた範囲内になったときに、前記係合手段を係合状態とする係合制御手段とを備えることを特徴とするハイブリッド車両。

【手続補正 3】

【補正対象書類名】明細書

【補正対象項目名】0012

【補正方法】削除

【手続補正 4】

【補正対象書類名】明細書

【補正対象項目名】0013

【補正方法】変更

【補正内容】

【0013】（4） 前記発電機制御手段は、前記発電機の回転数の変化率を予め定められた範囲内に制御する上記（1）ないし（3）のいずれかに記載のハイブリッド車両。

【手続補正 5】

【補正対象書類名】明細書

【補正対象項目名】0032

【補正方法】変更

【補正内容】

【0032】となる。また、リングギヤRからユニット出力軸14に出力されるトルク（以下「リングギヤトルク」という）を $TR (=TOUT)$ とし、エンジン11のトルク（以下「エンジントルク」という）を TE とし、発電機トルクを TG としたとき、 TR 、 TE 、 TG の関係は、図3に示されているように、

【手続補正6】

【補正対象書類名】明細書

【補正対象項目名】0037

【補正方法】変更

【補正内容】

【0037】次に、本発明のハイブリッド車両の制御系について、図4のブロック図に基づいて詳細に説明する。本実施形態の制御系を構成する制御手段は、車両制御装置41と、エンジン制御装置42と、モータ制御装置43と、発電機制御装置44とを有している。これらの制御装置41、42、43、44は、例えばCPU（中央処理装置）、各種プログラムやデータが格納されたROM（リード・オンリー・メモリ）、ワーキングエリアとして使用されるRAM（ランダム・アクセス・メモリ）等を備えたマイクロコンピュータによって構成することができる。

【手続補正7】

【補正対象書類名】明細書

【補正対象項目名】0076

【補正方法】変更

【補正内容】

【0076】 $TG = TG^*$ となった後、時刻 t_{22} にお

いて、クラッチCが解除（OFF）され、同時に発電機回転数 NG は、回転数変化率の上限を越えないように目標回転数 NG^* へ向けて下降し始める（点線 k ）。また、モータトルク TM には、発電機トルク TG の変動に応じた補正トルク ΔTM が加えられる（点線 m ）。発電機回転数 NG は、急激に下降することなく（点線 n ）、目標回転数 NG^* に到着する。以上のように、発電機制御手段によって発電機の回転数を制御すると、差動歯車装置を介して駆動出力軸に出力される出力トルクが変動する。ここで、駆動出力軸に連結されている電気モータのモータ出力トルクを、トルク補正手段により、出力トルクの変動に応じて補正することにより、走行感覚を損なうことなく、係合手段の係合ができる。発電機回転数制御時に生ずるトルク変動を、モータトルクを補正して吸収するため、走行感覚を良好な状態に維持することができる。

【手続補正8】

【補正対象書類名】明細書

【補正対象項目名】0082

【補正方法】削除

【手続補正9】

【補正対象書類名】明細書

【補正対象項目名】0083

【補正方法】変更

【補正内容】

【0083】請求項4に記載の発明は、発電機回転数の変化率を予め定められた範囲内に制御することで、発電機回転数の急激な変化が抑制され、エンジンの燃費や排ガス量等に対する悪影響を少なくすることができる。